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Response to Comments for Final Rules

Volume I

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On April 6, 1983, EPA published in the Federal Register (48FR 15076) proposed standards for certain categories of radionuclides. This report summarizes major concerns and issues arising from written and oral comments on the April 6 proposed, as well as EPA's response to these.

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1.0 INTRODUCTION

In 1977, Congress amended the Clean Air Act (the Act) to address airborne emissions of radioactive materials. Before 1977, the emissions were either regulated under the Atomic Energy Act or unregulated. Section 122 of the Act required the Administrator of the Environmental Protection Agency, after providing public notice and opportunity for public hearings, to determine whether emissions of radioactive pollutants cause or contribute to air pollution that may reasonably be anticipated to endanger public health. An affirmative determination was made, and EPA published a Federal Register notice on December 27, 1979, listing radionuclides as hazardous air pollutants under Section 112 of the Act.

On April 6, 1983, EPA published in the Federal Register (48 FR 15076) proposed standards for certain source categories of radionuclides. At the same time, EPA proposed not to regulate other source categories of radionuclides. Specific standards were proposed for sources in four categories: (1) Department of Energy facilities, (2) NRC-licensed facilities and non-DOE Federal facilities, (3) underground uranium mines, and (4) elemental phosphorus plants. EPA did not propose standards for uranium fuel cycle facilities, uranium mill tailings, management of high-level waste, low-energy accelerators, coal-fired boilers, the phosphate industry, and other extraction industries. At the time of proposal, it was thought that these nine categories were all that potentially released radionuclides to air at levels that could warrant regulation. In addition to giving notice of EPA's proposed actions, comments were solicited on all aspects of the proposed rulemaking with particular emphasis on the general methodology used to prepare the standards, the standards themselves, and the determinations not to propose standards. Comments could be made in the form of written entry to Docket No. A-79-11 opened for this express purpose and/or in the form of testimony given at public hearings on the matter.

Informal public hearings were held on April 28 and 29, 1983, in Washington, D.C., and the record was held open an additional 30 days for submission of written comments to the docket. In response to numerous requests, an additional 45-day period was granted to receive comments and a second informal hearing was held on June 14, 1983, in Denver, Colorado (48 FR 23665).

Copies of the written comments and transcripts of the hearings are available for inspection and copying at EPA's Central Docket Section, West Tower Lobby, Gallery One, Waterside Mall, 401 M Street S.W., Washington, D.C. 20460.

This document summarizes major concerns and issues arising from written and oral comments on the proposed rulemaking, as well as EPA's response to these. Each commenter is identified by a letter and number after the comment. The response to the comment then follows. In the interest of clarity and economy, some comments are paraphrased, and some closely related comments are combined. A list of the commenters and their identification numbers is given in Appendices A, B, and C.

2.0 OVERALL COMMENTS

2.1 Basis for the Standard

Comment 2.1.1a: Notwithstanding Section 122 of the Act and the EPA's draft Toxic Air Pollutants Policy, the EPA did not seriously consider regulatory alternatives when it listed radionuclides under Section 112. Thus, in making this proposal, the EPA failed to consider regulating emissions from DOE and NRC-licensed facilities under its general authority to issue Federal radiation protection guidance. Similarly, for uranium mines and elemental phosphorus plants, where the risks are to small, close-in populations, the EPA fails to consider that regulation by State or local governments might be more appropriate. (I-53)

Comment 2.1.1b: The listing and the proposal are in violation of the Clean Air Act, which requires under Section 122 that the EPA finds a significant risk before imposing any regulations. Sections 108, 111, and 112 must then all be considered. Further, to invoke Section 112, the presence of an extreme hazard to public health must be established. Nowhere in the record can a discussion, in compliance with the principle of reasoned decisionmaking, be found to justify the EPA's course of action. (I-3b, I-20a, I-53)

Comment 2.1.1c: Under Section 122, the EPA is required to show that a pollutant poses a significant risk. Under the rule established in Ethyl Corporation v. EPA, adopted by Congress in the 1977 amendments to the Act, to constitute a significant risk, a source category "must make more than a minimal contribution to total exposure" and there must be "a significant increment to the total human burden." All emissions of radionuclides from industrial processes contribute less than 1 percent of the population dose from radon. Even emissions from uranium mining, which has the largest emissions of any source category considered, have been shown by the EPA and the NRC to present an insignificant incremental risk. Thus, there is no basis for applying any regulatory program under the Clean Air Act. (I-3b, I-4b, I-20a)

Comment 2.1.1d: When determining the significance of risk under the scope of Section 122, Congress did not intend the carcinogenicity of a substance to be the determining factor. It was understood that each of the four unregulated pollutants identified in Section 122 were carcinogenic. The determination:

a. must be based on a consideration of the levels of exposure actually occurring or reasonably anticipated to occur;

b. should be made with respect to subcategories for the named pollutants;

c. must be based on a source category basis, considering the incremental addition to the existing burden in the atmosphere; and

d. should consider all available relevant information and proceed only after opportunity for public comment and hearing. (I-3b, I-20a)

Comment 2.1.1e: By use of the phrase "which may reasonably be anticipated" in Section 122 (as well as 108, 111, and 112), Congress imposed on the EPA the burden of reasoned decisionmaking with respect to both its endangerment determination and its listing decision. Under this rule, the EPA "must make plain its course of inquiry, its analysis, and its reasoning." The EPA has failed to do this:

a. Nowhere in the listing or the proposal does the EPA "make plain its course of inquiry, its analysis, and its reasoning."

b. Nowhere does the EPA evaluate the risks in terms of comparative assessment of risk, despite Congress' view that this is necessary.

c. The Agency has not provided a full explanation of all assumptions or an estimate of the margin of error in the dose and risk estimates.

d. The EPA has not evaluated the relative or incremental doses or risks.

e. The EPA gives no consideration to the risks associated with emissions at the levels occurring or whether the risks may be due only to certain subcategories of radionuclides. (I-3b, I-20a)

Comment 2.1.1f: The EPA's position is contrary to law under the Clean Air Act. In Ethyl Corporation v. EPA supra, the court held that the EPA could regulate incremental contributions to a problem only if the incremental contributions were a significant source of overall exposure. Thus, since the sources the EPA proposes to regulate are negligible with respect to the background and unregulated sources, the EPA's listing of these under Section 112 is contrary to law. (I-47)

Comment 2.1.1g: Emissions already regulated under the Atomic Energy Act clearly pose an insignificant danger at current and reasonably expected emission levels. The permitted emission levels have been found adequate "to protect life, health and safety." Crowther versus Seaborg, 312 F. Supp. 1205, 1234-35 (Denver, Colorado 1970). Similarly, Dr. Sinclair of the National Council on Radiation Protection and Measurements (NCRP) has indicated that such levels are safe. Thus, the EPA should not list radionuclides emitted by Atomic Energy Act licensees for regulation. (I-47)

Comment 2.1.1h: The risk of adverse health effects from radionuclides is insignificant when compared to the risk of lung cancer generally and the risk from commonplace events (i.e., drowning or accidental poisoning). (I-3b)

Comment 2.1.1i: The EPA has failed to establish that emissions from uranium mining or milling sources either present a significant risk within the meaning of Section 122 or result in the consequences specified under Section 112. In fact, the EPA concluded, in its recent report to Congress, that these potential effects [of active and inactive mines] are not of sufficient magnitude to warrant corrective measures. The Nuclear Regulatory Commission's Atomic Safety and Licensing Appeals Board has also concluded that there is serious doubt as to whether fuel cycle emissions have a significant impact upon human health, and that this doubt is reinforced by the fact that the emissions are vanishingly small compared to the fluctuations in natural radon from place to place. (I-3b, I-22, I-23)

Comment 2.1.1j: Congress did not intend processors and users of materials that might contain trace quantities of hazardous pollutants to be regulated under the CAA. (I-3b)

Response (Comments 2.1.1a through j): Commenters state that when EPA determined radionuclides are a hazardous air pollutant (44 FR 76738) it made the following errors: (1) did not consider properly other alternatives and made other procedural errors, (2) considered risks to be significant when they were not, (3) did not explain risk estimates in sufficient detail, and (4) did not make plain its course of inquiry. The commenters imply that if the determination is in error, then the proposed regulation should be withdrawn.

EPA believes that its determination under Section 122 of the Act that radioactive materials will cause or contribute to air pollution which may reasonably be anticipated to endanger public health was correctly made. It was based on overwhelming evidence that radionuclides are carcinogenic. There is an increase in risk of many kinds of cancer when people are irradiated due to the presence of radionuclides in the environment. Also, it was based on the observations that radionuclides are used in large quantities and that some facilities emit significant quantities of radionuclides into air, with a potential for much greater releases. As EPA explained in the original notice, these reasons are sufficient to make a determination there is endangerment to public health.

Comparisons with the risks due to natural background radiation are not relevant. (See response to Comment 2.1.1l.) Also, comparisons of potential risks due to emissions with the risks of cancer or other kinds of risks such as the total risk of cancer, are inappropriate. Commenters do not demonstrate that considerations of such high risks lead to conclusions with respect to risk levels that are protective of public health with an ample margin of safety. For example, given the large societal efforts to reduce the risk of cancer further, there is reason to judge this risk unacceptable. The Agency cannot then argue a certain fraction of these risks are acceptable. Finally, the Agency has not defined a level of risk that is so low that everyone can agree no effort is needed to reduce it even when the cost to do so is small. The Agency concludes that the risks due to radionuclides, considered as a class, are significant and that large quantities are in use so that additional significant risks in the future are possible unless there is constant vigilance on the part of users and the regulatory agencies.

Section 122 requires a generic determination based on the hazard from a specific kind of air pollutant, without regard to other statutory authorities. When this decision was made in the affirmative, there is a choice as to the section of the Clean Air Act under which to regulate radionuclides. EPA believes that the decision to use Section 112 was correct because the carcinogenicity of radionuclides fits the definition of a hazardous air pollutant.

EPA believes it has explained its risk estimates in sufficient detail. The Background Information Document and the various Federal Register Notices make plain EPA's computer codes, EPA's assumptions for each source of radionuclide emissions, and the basis for calculating risk estimates. All procedures are documented and can and have been reproduced by others. All procedures have been reviewed and generally accepted in the scientific community.

The Agency has made plain on numerous occasions its position that risk estimates are not exact calculations but are presumed accurate only to an order of magnitude. EPA makes no pretense that its risk estimates are so accurate that they become the sole basis for our decisions. Rather, risk estimates are projections which, along with other considerations, have led to a determination of hazard with respect to radionuclides.

Comment 2.1.2a: There is considerable evidence that Congress intended that non-threshold carcinogens be regulated under Section 112. (P-3b)

Comment 2.1.2b: Radionuclides should not be regulated under Section 112. This portion of the Clean Air Act is to be used in cases where the pollutant in question is extremely hazardous and poses a significant risk to human health. (I-3a, I-3b, I-4c, I-20a, I-20b, I-31, I-47, I-49)

Comment 2.1.2c: Section 112 of the Clean Air Act is an unconstitutional delegation of the legislative function to an administrative agency. The only direction the EPA was given in Section 112 was to establish standards that provide "an ample margin of safety." The term is vague and, for pollutants with no threshold effects, does not offer the guidance that Congress must provide. The only way this constitutional issue may be avoided is if Section 112 is implemented as Congress intended, that is, only in those limited instances where extreme health hazards are shown. (I-3b)

Comment 2.1.2d: The commenter strongly disagrees with any proposed attempt to delist radionuclides. Based on evidence that radionuclides cause cancer and genetic damage, the EPA correctly concluded that radionuclides are hazardous air pollutants. Section 112(b)(1)(B) states that the Administrator may not remove a substance from the list "unless he finds ... that such a pollutant is clearly not a hazardous air pollutant." Mere assertions that risks are not significant or the presentation of limited data will not suffice. (P-17)

Comment 2.1.2e: It does not appear that the EPA followed the policy set forth in the Federal Register of October 10, 1979 when setting the proposed radionuclide standards. We understand that the EPA may have based the proposed rule on a new toxic air pollutant policy that is still under development and has not been published. (I-1b)

Comment 2.1.2f: Section 112 of the Clean Air Act does not recognize the problems inherent in establishing standards for carcinogens, for which no threshold exists. The proposed EPA airborne carcinogen policy indicates that regulation of these materials should include consideration of risk. (I-1a)

Comment 2.1.2g: It was proper of EPA to list radionuclides as hazardous air pollutants under Section 112 of the Clean Air Act, and any derivative standards must insure an ample margin of safety. (P-3a)

Comment 2.1.2h: The Atomic Industrial Forum concurs that standards are not needed under Section 112 of the Clean Air Act for uranium fuel cycle facilities, uranium mill tailings, and high level wastes. (I-1a)

Comment 2.1.2i: The EPA has offered no rationale for treating emissions of regulated radionuclides or any subcategory of regulated radionuclides as "extremely hazardous;" therefore, regulation under Section 112 is not justified. (I-47)

Comment 2.1.2j: The EPA's consideration of the five factors used in evaluating each source category is consistent with the mandate of Section 112 of the Clean Air Act. In addition, the benefits society derives from the activity that produces the potential radiation exposure should be evaluated. (I-45)

Response (Comments 2.1.2a through j): Comments were received both for and against the regulation of radionuclides under Section 112 of the Act. Some commenters believe that the radionuclides are not hazardous enough to warrant regulation under Section 112. Other commenters agreed with listing radionuclides under Section 112 and objected strongly to attempts to delist radionuclides.

Radionuclides were listed under Section 112 of the Act in the following way. After providing public notice and opportunity for public hearings (provided by 44 FR 21704, April 11, 1979), the Administrator determined radioactive pollutants cause or contribute to air pollution that may reasonably be anticipated to endanger public health. On December 27, 1979, EPA published a notice in the Federal Register listing radionuclides as hazardous air pollutants under Section 112 of the Act (44 FR 76738, December 27, 1979).

The listing under Section 112 of the Act was made for the following reasons:

- Radionuclides are considered to be carcinogenic without a threshold when ingested or inhaled.
- Radionuclides are widely used, often in very large amounts, and, in some cases, there is significant potential for unnecessarily high radionuclide emission rates into air.
- Radionuclide emission rates at current levels cause significant levels of risk in some cases.
- Radionuclides are emitted to air from many different facilities.

The statutory criterion for delisting radionuclides is that the Administrator finds that "the pollutant clearly is not a hazardous air pollutant." This criterion has not been met. The record supports the listing as correct, and EPA is not delisting radionuclides.

The Office of Radiation Programs did not base its proposed standard on a new toxic air pollutant policy that has not been made public. EPA's proposed policy for regulating hazardous air pollutants, published in the Federal Register on October 10, 1979, is being reconsidered but has not yet been withdrawn or replaced. The proposed standard for radionuclides conforms with EPA's proposed policy.

Some commenters stated that radionuclides should not be listed under Section 112 because EPA has not demonstrated radionuclides are "extremely hazardous." The statutory criterion for listing under Section 112 is that radionuclides, in the judgment of the Administrator, cause or contribute to air pollution which may reasonably be anticipated to result in an increase in serious irreversible, or incapacitating reversible, llness. The record strongly supports the conclusion that radionuclides meet this criterion because of their carcinogenicity and wide use in very large quantities. The benefits society derives from the activities involved are irrelevant to the use of Section 112. Under law, the decision to list radionuclides under Section 112 was correct.

Comment 2.1.3: Section 111 would provide a more appropriate regulatory program for radionuclides. To the extent that radionuclides present a significant health risk, the risk would appear to be possible only in a small area adjacent to a source. This is the condition for which Congress intended that controls be considered under Section 111(d). Senate Report No. 91-1196 in fact included radioactive substances on a list of substances most likely to be covered under Section 111. (I-3b, I-49)

Response: Commenters state that radionuclides should be listed under Section 111 rather than 112, principally because the risks associated with radionuclides are localized.

EPA disagrees with this comment. Radionuclides are carcinogens for which the Agency assumes there is no concentration threshold. Hazardous materials with this kind of serious effect are best listed under Section 112 where costs are a secondary consideration. Section 111 of the Act is used primarily for stationary sources emitting pollutants for which thresholds exist, an example being sulphur dioxide emissions. Section 111 specifically requires the Agency to consider costs. (Section 111(a)(1)(C))

Comment 2.1.4a: Under the principle of in pari material, the EPA is required to give effect to all statutes that govern a particular source. Thus, under Section 112, the EPA is required to regulate sources that meet its requirements, including uranium fuel cycle sources, high-level waste disposal sites, and uranium and thorium mill tailings. (P-15a, P-15b)

Comment 2.1.4b: In determining whether other regulatory schemes are adequate to preclude the need for regulation under Section 112, the Agency should consider: health standards set with an ample margin of safety without regard to technological feasibility and costs, standards set as emission standards, the right of public access to emission data, and the right of citizen enforcement. None of these provisions, or their equivalent, are found in the Atomic Energy Act, the Uranium Mill Tailings Radiation Control Act, or the Nuclear Waste Policy Act. Thus, standards must be adopted under the CAA. (P-15a)

Comment 2.1.4c: The EPA fails to explain why some facilities emitting more radionuclides than some of the sources regulated under this proposal are not subject to these standards. (G-19)

Comment 2.1.4d: We concur with the EPA's decision to consider standards on a source-by-source basis. Such a rationale is clearly supported by the Act. The Act does not require CAA standards where other regulations already exist that accomplish the same goals, nor does it require regulation of insignificant sources to guard against possible future increases. (I-4a, I-4b)

Response (Comments 2.1.4a through d): Commenters both agree and disagree with EPA's determinations not to regulate specific groups of sources that emit radionuclides to air.

There are two separate issues here. EPA considered both of them:

1. Should EPA propose regulations for all facilities emitting detectable amounts of radionuclides?

2. Should EPA propose regulations under the Clean Air Act for sources whose radionuclide emissions are controlled under other EPA regulations, either regulations specifically for radionuclides or regulations limiting particulate emissions, thus controlling radionuclide emissions also?

Radiation detection equipment is extremely sensitive. Consequently, every stack in the country discharges to air detectable quantities of naturally-occurring radionuclides. Given enough resources, even the most minute quantities can be measured. Those sources emitting extremely small quantities of radionuclides have not been categorized or analyzed by EPA because the risks to individuals and to population groups are minimal.

Because of the large amounts of resources needed to propose and promulgate an emission standard, EPA disagrees with the comment that major EPA standards such as apply to the uranium fuel cycle, uranium mill tailings, and high-level wastes should be duplicated by Clean Air Act standards. The Agency is aware that the use of the Clean Air Act confers certain advantages that other authorities do not, such as the right of suit by a member of the public. However, it is EPA's judgment that the effort and expense of issuing duplicate standards would be excessive without any reasonable expectation of improved public health protection. The public is better served if the Agency's resources are used elsewhere. Comment 2.1.4c has been rendered moot by EPA's decision to withdraw the proposed standards.

Comment 2.1.5a: The EPA was correct in rejecting a zero-risk interpretation of Section 112. It pointed out that the language of Section 112 does not imply the absence of all risk and correctly recognizes that to remove all risk would require the elimination of all emissions, a move that in most cases would require the closing of major industrial and utility facilities. (I-4b, I-4c, I-42, I-53)

Comment 2.1.5b: The requirement that emission standards be established with an "ample margin of safety" does not require a zero emission limitation. ection 112, unlike Section 115, does not use the term "prohibition." This difference cannot be ignored. In addition, references to zero emissions in the legislative history are not unequivocal. (I-3b)

Comment 2.1.5c: Even if radionuclides are hazardous air pollutants, a zero or near-zero emission standard is not required by the Clean Air Act. The legislative history provides little guidance in defining the phrase "ample margin of safety." Administrator Ruckelshaus noted that for non-threshold pollutants, there is no way to establish a perfectly "safe" level of exposure, but called for an approach comparing risks and benefits. In addition, Justice Stevens noted that safety is not the equivalent of risk free. (I-47)

Response (Comments 2.1.5a through c): Commenters generally agree that EPA was correct in rejecting a zero-risk interpretation of the Clean Air Act (Section 112).

This comment raises an issue that is similar to 2.1.4, but more extreme. It has been suggested that the language of the Clean Air Act requires EPA to prevent all emissions of radionuclides to air regardless of the disruptions and cost to the industry and, thus, to reduce the risk from radionuclide emissions to zero.

As pointed out in the response to 2.1.4, probably every stack in the country discharges into air minute quantities of radionuclides which could be measured given enough resources. These emissions cause, in theory, some risk greater than zero. Thus, attempting to achieve an actual zero level of risk is impossible. Either EPA must reject the possibility of implementing Section 112 for non-threshold carcinogenic materials on a technicality, or EPA must proceed on the grounds that the intent of Congress and of the Act does not mean literally a "zero risk." EPA has adopted this second course which it believes to be the more reasonable.

EPA agrees with the comment that protection of the public with an ample margin of safety is not the equivalent of risk free.

Comment 2.1.6a: The standards are inconsistent with the Clean Air Act requirement that they provide an ample margin of safety. The Federal Register notice concedes that the standards will allow one death for every 500 people exposed to radioactive radon from uranium mines. (G-22, P-15a)

Comment 2.1.6b: The EPA has adopted an approach to setting standards that is in conflict with the health protection requirements of the Clean Air Act. The commenter can see no justification for a standard that leaves people exposed to risks as high as 1 chance in 500 of contracting cancer. (P-17)

Comment 2.1.6c: The proposed standards are not adequate to protect the public health and safety with an ample margin of safety as required by Section 112. The need to do this is clearly supported by the legislative history. Further, an actual emission limitation must be issued unless there is overriding justification for not doing so. In Section 109, Congress has indicated that an "adequate margin of safety must protect sensitive individuals." By definition, an "ample margin of safety" requires a more protective standard than an "adequate margin of safety." (P-3b, P-15a)

Comment 2.1.6d: The regulations should be built around a policy that interprets "ample margin of safety" as allowing a risk no greater than 1 in a million. (P-15b)

Comment 2.1.6e: In deciding whether limitations beyond BAT are to be required, EPA should focus not on whether emissions would otherwise be significant, but rather on whether an unreasonably high health risk would exist in the absence of more stringent control requirements. (I-42)

Comment 2.1.6f: The proposed rules ignore the principles of good safety regulation or practice. Authorized levels should be set below derived or estimated health risk levels. Further, limiting exposure by requiring ALARA or BAT is also good practice. However, setting BAT levels by regulation and varying levels is inconsistent and inappropriate. (I-32)

Comment 2.1.6g: The EPA's technology-based rationale makes the proposed standards unauthorized and unlawful, since standards must be based on health risk rather than best available control technology. The Administrator must prove (by comparative risk assessment) that current regulations do not provide an ample margin of safety. (G-1b, G-3)

Response (Comments 2.1.6a through g): Commenters seem divided on the issue of whether EPA's proposed standards provide an ample margin of safety. Given that we cannot achieve a zero level risk, what level of risk is equivalent to protection of public health with an ample margin? Where should emission levels be set for carcinogenic materials with no threshold?

Needless to say, EPA has not found an easy answer to this question. The Agency examined the idea of a de minimus level of risk, one that was so low that virtually everyone would agree that there is no need to reduce it further because public health is amply protected at this level. Comment 2.1.6d is an example of this approach, and EPA would agree that a fatal cancer risk of one chance in one million over a lifetime is very small, probably on the order of a de minimus risk level. In practice, such a level of risk would be associated (for Low LET radiaion) with 0.05 mrem/y whole body exposure or 0.2 mrem/y to the lung. Such a low emission limit would be disruptive in the extreme, limiting the generation of electricity by both coal and nuclear power, as an example.

If the Agency reasonably cannot limit emissions either to a zero risk level or to a true de minimus level, then it must use judgment as to what is an ample margin of safety, basing its judgment on various factors. These factors were previously discussed in the Federal Register notice that proposed these regulations. EPA emphasized at that time that there were no formulas to balance such factors in a quantitative way, but that in the end, it came to the use of the Agency's reasoned judgment as to what emission levels should be.

EPA has withdrawn its proposed standards for elemental phosphorus plants, Department of Energy facilities, and Nuclear Regulatory Commission licensed facilities and non-DOE Federal facilities, because it believes current practices limit risk to levels that are protective of public health with an ample margin of safety. While individual risks for a few facilities were at a level that might have led to a decision to regulate if this were the only criterion for judgment, there are other considerations, including low aggregate population risks, that argue against the need for regulations. It is the Administrator's judgment that the present record does not support the conclusion that regulation is necessary for these source categories.

EPA considers the risks due to radon emissions from underground uranium mines to be significant and believes action is necessary to protect populations and individuals living near them. EPA's most recent estimates of the lifetime risks to individuals living near these mines range from one in one thousand to one in one hundred. The potential exists for even higher risks in some situations, e.g., a person living very close to several horizontal mine vents or in areas influenced by multiple mine emissions. Lifetime risks in these situations can be as high as one in ten. The fatal cancer risks to the total population, both regionally and nationally, is 5 fatal cancers/year.

Because radon-222 is a noble gas and the volume of air discharged through mine vents is very large, there is no practical method to remove radon-222 from the mine exhaust air. Adsorption onto activated charcoal is the most widely used method for removing noble gases from a low volume air stream. However, application of this method to the removal of radon-222 from mine ventilation air at the volumes of air which must be treated would require large, complex, unproven systems which would be extremely costly (i.e., at least $18-44/lb of U_3O_8). Therefore, it is the Administrator's judgment that it is not feasible to prescribe or enforce an emission standard for radon-222 emissions from underground uranium mines because radon-222 cannot be emitted through a conveyance designed to capture the gas under current conditions. Instead, EPA has decided to begin development of work practice, design, equipment or operational standards to control radon releases from underground uranium mines. An Advance Notice of Proposed Rulemaking announcing this decision is published as a part of this rulemaking.

Comment 2.1.7a: The EPA's use of costs to industry to undercut protection of the public is unjustified and unlawful. (G-22, P-15a)

Comment 2.1.7b: The commenter does not believe that Section 112 gives the EPA any authority to perform cost-benefit analyses in order to set standards. The inadequate definition of BAT together with a poor examination of the presence of an "unreasonable residual risk" does not satisfy the mandate of the Clean Air Act. The following approach is suggested:

a. All sources of significant amounts of radionuclide emissions should be subject to standards.

b. These standards should reflect the lowest emissions achievable using the most effective control technology currently in use or that has been demonstrated and is readily available.

c. If the remaining emissions are predicted to add to the lifetime risk of the most sensitive individual by an amount greater than one in a million, technology-forcing controls should be required. (P-17)

Comment 2.1.7c: The EPA has relied on a legally flawed approach to developing its proposed standards for all source categories. Protection of public health must be the primary criterion, not technological feasibility and/or costs. (P-15a)

Comment 2.1.7d: The EPA must abandon its BAT/unreasonable residual risk approach since it is contrary to the mandate of the Clean Air Act. (P-17)

Comment 2.1.7e: Economic, non-air impact, and energy requirements should not be considered for standards issued under Section 112. (G-24, P-3a)

Comment 2.1.7f: The Act prohibits consideration of cost to the polluter when considering the levels of control needed to protect public health. (P-15a, P-15b)

Comment 2.1.7g: Consistent "dollars per health effect averted" criterion should be used when developing standards for the many sources involved. (I-1b, I-50, I-53)

Comment 2.1.7h: Under Section 112, cost may be considered both in determining whether to regulate and in establishing the appropriate level of control. As the EPA has recognized, cost-effectiveness is the only means by which standards for a non-threshold pollutant can be established. This strategy has been used in previous applications of Section 112 and was judicially recognized in Adamo Wrecking Co. v. United States. (I-3b, I-53)

Comment 2.1.7i: Basing the standards on what the facilities can achieve at reasonable cost is grossly inadequate under the CAA. EPA's rejection of a cumulative population standard and/or direct emission limits for specific groups of facilities is unjustified. (P-17)

Response (Comments 2.1.7a through i): Most commenters have questioned EPA's use of control technology costs as a factor in developing the proposed rules. A few recommend the use of cost-effective or cost-benefit studies as a means of establishing emission levels.

EPA agrees with comments that state that the Clean Air Act precludes the use of a cost-effective or cost-benefit analysis as the primary basis for emission standards established under Section 112, and the Agency has not done so. In developing these final actions, EPA has considered the availability and practicality (cost) of control equipment to a degree. It is not reasonable to do otherwise. When making judgments on the level of emission standards or on the need for emission standards, it is highly desirable to know whether control technology exists or not, whether best available control technology is being used, and whether the cost of control technology is reasonable compared to the cost of the facility and operating costs. EPA believes this is within the intent and spirit of Section 112 of the Clean Air Act.

The premise of cost-effective or cost-benefit analysis is that the risks to surrounding populations can be accurately calculated and that these risks can somehow be accurately balanced against the cost of control technology and the benefits of the activity with sufficient precision to establish an emission limit or to demonstrate the lack of need for an emission limit. First of all, it is the Agency's opinion that such a procedure is not allowed when developing standards under Section 112 of the Clean Air Act. Congress clearly intended that public health protection is primary and costs a secondary (some would say impermissible) consideration. Second, because of the large numbers of different kinds of activities, the varying benefits of these activities, the varying costs and effectiveness of very complex types of control technologies, and the uncertainty associated with risk estimates, a cost-benefit analysis would be extraordinarily complicated and not accurate or precise. Third, it is the Agency's experience based on more simple situations that cost-effectiveness analysis may lead to results that are not sufficiently protective of those persons living closest to the plant. While large populations may be protected to a degree most would find ample, those nearest individuals would have unreasonably high risks because cost-effectiveness results for populations may not require the use of available technology. This unwelcome result arises because available control technology for radionuclides is usually not costly compared to facility and operations costs, and so is installed routinely, without a cost-effectiveness analysis. This use of available control technology for carcinogenic materials is generally considered to be prudent policy and protective of public health, while failure to require such technology is inequitable.

Protecting the public closest to the facilities considered in this rulemaking with an ample margin of safety also provides ample protection of populations. Doing the reverse, only protecting populations, does not always protect individuals, and EPA believes that both individuals and populations should be protected with ample margins of safety.

Comment 2.1.8a: The EPA should make an effort to explain carefully the rationale for its action, including the perspective with respect to national and international protection guidance based on data developed by groups such as BEIR, NCRP, ICRP, and UNSCEAR. (I-1b, I-38, P-1b)

Comment 2.1.8b: The NCRP/ICRP general population radiation dose limits should be adopted as the basis for emissions limits on radionuclides under Section 112 of the Clean Air Act. (G-23, I-45)

Comment 2.1.8c: The EPA should adopt the NCRP limits and ALARA for all source categories. For sources already regulated, the EPA should set a regulatory cut-off limit of 10-30 mrem/y so compliance can be monitored rather than calculated. (I-38)

Comment 2.1.8d: National and international scientific organizations who maintain continuing review of radiation bioeffects data conclude that existing public dose standards remain generally valid. (I-1a)

Comment 2.1.8e: The EPA should base standards on scientific evidence and the recommendations of advisory bodies such as the ICRP and the NCRP. This would promote public confidence and a stable regulatory environment in which the benefits of nuclear science and technology could be enjoyed. (G-1b)

Response (Comments 2.1.8a through e): Commenters request EPA to make more use of radiation protection guidance developed by national and international groups such as the NRCP and ICRP. EPA is asked to adopt the general population dose limits recommended by these groups as the basis for radionuclide emission limits. In particular, the Agency is asked to base risk estimates on the recommendation of the BEIR-3 committee report, rather than the recommendations of the BEIR-1 committee.

EPA agrees with the comment that it would be more appropriate if BEIR-3 recommendations on risks due to radiation are used. Accordingly, risk estimates in the Final Background Information Document are based on BEIR-3 information. In most instances, the risk estimates change very little, less than 5 percent. In some cases where the lung or the bone is the primary organ being irradiated by alpha particles, total risk may be reduced as much as a factor of three. The change in risk estimates does not change estimates of dose.

The thrust of these comments seems to be that EPA should use 500 mrem/y whole body, 1500 mrem/y to any organ to the highest exposed individual as the basis for emission limits for radionuclides. These dose limit recommendations are the same as Federal Radiation Council (FRC) guidance. Such high dose limit recommendations are generally recognized as maximum or upper limits, not to be exceeded or even approached without good reasons. A person receiving 500 mrem/y to the entire body for a lifetime would have an increased potential total cancer risk of about one in one hundred due to the irradiation. Both the ICRP and NCRP note that such risk limits are not appropriate when exposure to radionuclides is continuous over long periods of time, because their upper limits do not represent levels of exposure where risks are of small consequence.

ICRP, NCRP, and FRC guidance also specify that exposure to radiation should be kept as low as practicable. But such an admonition is not as precise or enforceable as a numerical standard and does not necessarily require or represent a low level of risk. However, the Agency recognizes that an emissions policy based on this guidance has led to generally low emissions of radionculides from most facilities.

Because of the efforts of various parties to keep emissions low, the doses to individuals living near emission sources are generally far below the maximum limits. This has enabled the Agency to find that current practice provides an ample margin of safety.

Comment 2.1.9a: We agree that the EPA should base standards on absorbed dose equivalent rather than specific concentrations of radionuclides. (I-33b, P-1b, I-1a)

Comment 2.1.9b: Dose-based standards set quantitative limits on emissions on a continuous basis, thus complying with Section 302(k) of the Act. (I-4b, I-4c)

Comment 2.1.9c: We agree with the EPA's decision to use dose type standards wherever the nature of the emission makes this practical. In the case of radon emissions from underground uranium mines, the air-concentration format appears acceptable. (I-1b)

Comment 2.1.9d: EPA's rejection of a cumulative population standard and/or direct emission limits for specific groups of facilities is unjustified. (P-17)

Comment 2.1.9e: The dose limit standard is not an acceptable form under Section 112(b). (P-15a, P-17)

Comment 2.1.9f: We support the EPA's use of a "dose to person" standard, since it relates directly to public health. (G-2a, G-2b)

Comment 2.1.9g: The proposed dose limit standard is not an acceptable form under Section 112(b). (P-15a, P-15b)

Comment 2.1.9h: The use of both whole body and organ dose limits runs counter to the ICRP concept of an effective whole body dose. The current scientific thinking in this area advocates a committed, effective dose equivalent as the proper standard. (G-2b, G-16, I-1b, I-31, I-40, I-47)

Response (Comments 2.1.9a through h): Most commenters agreed that an indirect emission limit in the form of a dose equivalent limit was a reasonable and appropriate form for the final rules. Other commenters disagreed, arguing that a dose equivalent limit was not acceptable.

EPA still believes that a dose-rate limit would be proper. However, since EPA is withdrawing the proposed dose-rate standards, these comments are not applicable.

Comment 2.1.10a: The rationale for the proposed rulemaking is particularly unclear and obscure and appears ill-advised and perhaps detrimental to the broad interests of society. (P-1b)

Comment 2.1.10b: Although we agree with the conclusions the EPA reached regarding coal-fired boilers, phosphate mining, and other extraction industries, the EPA's general analysis regarding radionuclides is not in accordance with the requirements of the Clean Air Act and does not consider all relevant information. (I-49, I-53)

Response (Comments 2.1.10a and b): Commenters question the data base and rationale for the proposed rule, implying EPA did not consider all relevant information.

EPA believes its data base and rationale were sufficient to support the proposed rules and are sufficient to support the final actions. Considerable additional information, in particular for uranium mines and elemental phosphorus plants, has been received from commenters and from additional EPA studies. The information is considered under responses to comments on the appropriate specific rules.

Commenters should be aware that EPA was directed by the Court to propose standards based on information at hand. The Court was of the opinion EPA had sufficient information to propose standards.

EPA believes, and its Science Advisory Board agrees, that EPA has gathered the appropriate scientific information needed for a risk assessment in a technically proficient manner and that this data and information was used to develop scientifically defensible approaches for modeling the transport of radionuclides through the environment from airborne releases, in calculating doses received by persons inhaling or ingesting this radioactivity, and in estimating the potential concern and genetic risks of the calculated doses. The final Background Information Document has been greatly modified to explain these procedures in more detail.

Comment 2.1.11a: The EPA has ignored the data base associated with both the exposure to and harm from natural background radiation. These data provide a rational, defensible basis for establishing the "ample margin of safety" required by Section 112. This information shows that not only is the proposed emission limit within the natural variation in background levels, but that the calculated resulting harm is indistinguishable from that occurring in the absence of emissions. (G-24, I-1b, I-38, I-50)

Comment 2.1.11b: The risk resulting from emissions from the sources that EPA is proposing to regulate is not significant because the dose is small compared to natural background levels. (I-1b, I-3b, I-38, I-47, I-49, P-1b)

Comment 2.1.11c: It is unreasonable to calculate incremental population doses to arrive at a number of projected deaths when the constituent individual doses are within the noise of background variability. (I-38)

Comment 2.1.11d: The proposed limit is a small fraction of the variation in natural background, cannot be measured, and represents a vanishingly small level of risk (between one in six million to one in forty million using the BEIR-3 estimates). It makes little sense to impose restrictions that are much smaller than the risks encountered in everyday living. (G-16, I-1b, I-31, I-33a, I-33b, P-1b)

Comment 2.1.11e: The proposed limits are less than the variation in natural background radiation levels. There is little data to support any change in cancer risk between high and low background areas. Thus, there is little reason to assume the proposed regulations will have any beneficial effect upon public health. (G-16, I-1b, I-17, I-33a, I-33b, P-1b)

Comment 2.1.11f: The EPA did not compare risks due to radionuclides with natural background risks. This implies a rejection of comparative risk analysis that is insupportable. (I-47)

Response (Comments 2.1.11a through f): Commenters question the need for the standard when dose to people is small compared to the dose due to the natural radiation background. They note that everyone is exposed to a natural radiation background of about 100 mrem/y to all organs of the body, with additional significant exposures of some lung tissue to radon decay products; these exposures vary greatly with location. This natural background having always been with us, they argue such exposure must be at a level that is protective of public health with an ample margin of safety, and, therefore, standards less than this are unreasonable.

EPA disagrees with this argument. Between 1 and 3 percent of fatal cancers have been attributed to the natural radiation background. This risk is significant (approximately 2 in 1000). EPA has concluded that the level of risk associated with background radiation should not be judged acceptable just because it is unavoidable.

The natural radiation background is not a good benchmark for hazardous material emission limits that are intended to be protective of public health with an ample margin of safety. Nor is an arbitrary fraction of the natural radiation background a useful rationale. Rather, several factors were considered by EPA in developing its proposed and final standards.

Comment 2.1.12a: There is no justification for refusing to consider the total risk posed by radionuclides and dozens of other hazardous materials present in the same particulate emissions and for considering only average risk when a substantial number of plants may be much more dangerous. (P-17)

Comment 2.1.12b: The EPA's failure to evaluate the impact from all sources in relative proximity (80km) to one another is a fatal flaw in the proposed standards. (P-15a, P-15b)

Comment 2.1.12c: The words "contribute to" in the Clean Air Act Amendments of 1977 require the EPA to address the cumulative effects of all sources of a pollutant when setting a standard. (P-15b)

Comment 2.1.12d: We can identify no provision for the assessment and associated regulation of multiple-source contributions to the dose for near-site individuals or populations. (I-34)

Response (Comments 2.1.12a through d): Commenters want EPA to consider the total risks posed both by radionuclides and other hazardous materials when present in the same particulate emissions. Also, EPA should consider the collective impact of all sources of radionuclide emissions within a small region.

EPA tends to agree with the first part of this comment, which appears directed primarily to coal-fired boilers. In theory, it would be best to consider the need for particulate controls for coal-fired boilers based on the total risks caused by all the hazardous constituents in particulates, not just radionuclides. However, the current state of knowledge does not enable EPA to estimate this total risk. For other reasons, EPA is limiting particulate emissions to low levels by requiring best available technology on new boilers. This limits the risks due to radionuclide emissions to low levels also. But it is not possible at this time to estimate risks due to combinations of radionuclides, other chemicals, and the particulates themselves.

The rulemaking record does not contain information on the frequency of situations in which an individual is affected by multiple sources. Based on available information about major sources, it appears that such situations are rare. For those rare situations which may occur, if one assumes that multiple sources increase the risk by a factor of two, EPA's decisions would not be different.

Comment 2.1.13a: The proposed regulations should be revised because they are not based on the best scientific information available and because they will inevitably increase the fears of people with only a little knowledge of the effects of radiation. (G-23, I-38, P-18a)

Comment 2.1.13b: In an area where misinformation and misunderstanding are prevalent, the inconsistent application of numerical limits, together with the establishment of unnecessarily restrictive limits, can only magnify the problem of radiation exposure in the eyes of an already confused public. (I-1b)

Comment 2.1.13c: If the EPA is meant to protect the environment, then it could better spend its time abating noxious and dangerous (and nonradioactive) gases discharged from the burning of fossil fuels. The EPA could aid the nation's mental health by reducing the anxiety evident at the mere mention of "radiation." (P-18a)

Comment 2.1.13d: The EPA should consider the effect of its proposed standards on the public's perception of safety. (G-1a, G-1b)

Comment 2.1.13e: The proposed rule is based on perception, rather than on fact, and will simply increase public concern with no increase in public health. (I-31, I-43b)

Response (Comments 2.1.13a through e): Commenters believe EPA should not promulgate the final rules because this action would increase the fears of people living nearby the regulated facilities.

EPA believes that this is not a valid reason for not promulgating final rules. The Clean Air Act does not permit this criterion to be used as a basis for emission levels.

Comment 2.1.14a: Application of BAT is contrary to the accepted ALARA principle of radiation protection. By accepted definition, ALARA includes a reasonable weighing of risks, benefits, and costs, and is also designed to be used on a site-specific basis. (I-3b)

Comment 2.1.14b: Incorporation of Best Available Technology, BAT, should be required by the regulations. Consistency between ALARA and BAT should be required and BAT should be applied on a case-by-case basis. (G-24)

Comment 2.1.14c: There is some ambiguity regarding application of the BAT requirement (48 FR 15079, col 2). The intent of the phrases "with allowance for variation in emissions" and "once a determination is made that additional controls are necessary" is unclear. (I-42)

Comment 2.1.14d: ALARA is a philosophy of operations and should not be quantitatively imposed as a regulation. (I-1a)

Comment 2.1.14e: The ALARA principle, if properly applied, leads to substantially lower doses than the present limits of 500 mrem/y to any individual and a suggested 170 mrem/y if the exposure is continuous. ALARA should not be quantified as part of the regulatory process. (P-1a, P-1b)

Comment 2.1.14f: 10 CFR 20, coupled with the ALARA principle, is a perfectly acceptable approach to the regulation of radionuclide emissions. (I-3a)

Response (Comments 2.1.14a through f): Commenters questioned EPA's use of Best Available Technology (BAT) and As Low As Reasonably Achievable (ALARA) as considerations when developing emission standards. EPA is asked not to "quantify" ALARA as a regulation, implying that EPA's proposed standards for DOE and NRC facilities do this.

EPA has withdrawn the proposed rules for reasons unrelated to these comments.

ALARA, as one commenter pointed out, is a philosophy of operations. It means that every process will be constantly scrutinized to insure that emissions are held to as low as reasonably achievable levels. In practice, this means available technology by definition, because "available" implies technology that is proven and in use, thus reasonable to use.

EPA has not chosen to establish numerical standards at levels that reflect ALARA principles because it does not appear necessary at this time.

Comment 2.1.15a: The EPA has not explained why the standards considered adequate for uranium fuel cycle facilities are two and one-half times higher than those justified for DOE facilities. (G-19)

Comment 2.1.15b: The EPA should develop generally applicable standards without regard to who operates the facility. (G-23, I-1b)

Comment 2.1.15c: A consistent risk basis should be used for all standards. (G-1b, G-24, I-1b)

Comment 2.1.15d: Although setting different standards for different industries is consistent both with the Clean Air Act and ALARA, it will lead to confusion. (P-1a, P-1b)

Comment 2.1.15e: The proposed standards are not consistent with 10 CFR 20 and 40 CFR Parts 190 and 191 proposed. In addition, the proposed 40 CFR Part 61 standards are not consistent among the four source categories. (I-34)

Comment 2.1.15f: No rationale is given for having three different standards for NRC licensees, DOE facilities, and uranium fuel cycle facilities. (G-2b, G-16, I-1b, I-31, I-32, I-40, I-47, P-1b)

Response (Comments 2.1.15a through f): Commenters stated all radionuclide emission standards should be based on the same level of risk. Therefore, standards should be generally applicable, not different, for all sources of emissions.

If standards are numerically different, it does not necessarily mean that they were based on inconsistent principles. For example, EPA's standard for the uranium fuel cycle promulgated under the Atomic Energy Act applies to all exposure pathways and to all sources that may be irradiating a single individual. Therefore, it is to be expected that such a standard would not be identical to a Clean Air Act standard established to limit air emissions only.

Comment 2.1.16: The EPA might consider expressing the standard as effective whole body dose such as is being considered by the NRC. Since whole body dose is normally controlling, the EPA statement that the proposed standards would have to be reduced to achieve comparable organ protection under a risk equivalent system does not seem justified. (I-1b)

Response: The commenter wishes EPA to consider using the effective whole body dose equivalent as a unit of measure for the final rule. Under this system all irradiations, whether to the entire body or to a part of the body, would be expressed as that dose to the whole body that would be equivalent based on consideration of risk. The Agency had specifically asked for comments on this question when the standards were proposed. There were few objections to this alternative. However, this issue is not relevant since EPA is withdrawing all its proposed standards.

Comment 2.1.17: The commenter agrees that the EPA should consider the potential for increased emissions and risk in the future. However, when it considered whether a Section 112 standard is required for a particular pollutant, the EPA should have also considered potential future reductions in public health risk. (I-42)

Response: EPA agrees with this comment and, in fact, did consider implicitly future reductions in public health risk. EPA would not have proposed a standard for sources believed to have both low emission rates and expectations that in the near term there would be changes such that there is no longer potential for risks to increase in the future. Such conditions would be met, for example, if a source had a limited operational lifetime or would no longer maintain large inventories of radionuclides.

Comment 2.1.18: The EPA should repropose the standards. The standards and associated background information should be widely disseminated and there should be 180 days for public comment. (I-34)

Response: EPA believes it did widely publicize its proposed standards and associated background information documents by means of mailing lists, Federal Register notices, and public announcements. Furthermore, EPA actively made contact with those organizations it believed were most interested or most affected by the proposed standards.

Originally, EPA allowed 60 days for comment, and then, in response to requests, extended the comment period an additional 45 days. EPA believes this is a reasonable period for public comment.

Comment 2.1.19: As the legislative history makes clear, the Act does not require decisions based on the "maximum exposed" individual, but to "sensitive citizens... who in the normal course of daily activity are exposed to the daily environment." The "maximum individual" defined in the EPA risk assessments is a theoretical construct, not a "sensitive citizen." (I-4b)

Response: The term "maximum exposed individual" refers to those people living closest to the facility at the point of highest risk. EPA intends that calculations of the dose equivalent to these people be made using realistic assumptions that do not grossly overestimate the risks. The Agency believes this is the intent of the legislative term "sensitive citizen." The Agency does not intend that dose calculations always be made at the site boundary using the most conservative assumptions. But for most facilities, it is reasonable to conclude that someone is living very close to the site boundary in the downwind direction, the usual location of the point of highest risk.

Comment 2.1.20: The Preamble to the proposal emphasizes population dose and risks, but does not address how they are used. Controlling exposure to the nearest off-site resident is reasonable if secondary consideration is given to collective population doses. (G-23)

Response: In deciding to withdraw the proposed standards, EPA considered both individual and population doses. In some cases, individual dose was high enough for regulation to be considered, but EPA is withdrawing the standard because, among other reasons, population doses were low.

Comment 2.1.21: The NESHAP requirements of the Act do not appear to justify considering the number of people exposed as part of the process of selecting the level of an emission standard. (G-24)

Response: EPA disagrees with this comment. Section 112(b)(1)(B) of the Act requires emission standards "at the level which (in the Administration's judgment) provides an ample margin of safety to protect the public health." EPA believes the term "public health" indicated a consideration of the nearby populations in addition to a consideration of nearby individuals. This is customary public health practice for pollutants widely dispersed in the environment.

Comment 2.1.22: In describing the circumstances under which extreme measures may be considered (following application of BAT), the EPA uses the phrase "significant emissions" (48 FR 15079, col. 2). It is more appropriate to consider the risk to the exposed population. (I-42)

Response: It is not necessary to consider one of these factors to the exclusion of the other. In making its decisions, EPA considered both.

Comment 2.1.23: Contrary to EPA's own proposed policy, it did not explicitly consider risk in establishing the proposed limits. (I-1a)

Response: EPA disagrees with this comment. EPA estimated risks for both individuals and populations for a wide variety of sources, including those for which standards were proposed. These risk estimates were one of the factors leading to the proposal of emission standards and the decision not to propose standards for other sources. However, EPA recognizes that risk estimates are uncertain. Risk was also the primary basis for the decision to withdraw the proposed standards.

Comment 2.1.24: The EPA does not provide adequate justification for the failure to set numerical emission limits in all cases. (P-3a, P-3b)

Response: For all categories except uranium mines, this comment has been rendered moot by EPA's decision to withdraw the proposed standards. For uranium mines, the Administrator has made a finding that it is not feasible to set a numerical emission limit.

2.2 Dose and Risk Calculations

Comment 2.2.1a: The use of extrapolated risk projections based on a linear non-threshold model produces risk estimates that are merely conservative upper-bound estimates. (I-20a, I-42, I-47, I-53, P-1b, P-18a)

Comment 2.2.1b: The linear non-threshold model was not devised to be used without consideration of other factors. The numbers that the model produces should not be confused with actual risk. (I-20a, I-47, I-53, P-1b)

Comment 2.2.1c: Presently available information indicates that it is not reasonable to assume that the risk associated with low doses is directly proportional to the risk that has been demonstrated at higher doses for low-LET radiations. (I-4b, P-1b)

Comment 2.2.1d: The EPA's use of the linear non-threshold theory is inappropriate in isolation from other factors and actual risk data. It represents the upper limit of risk at low doses. (I-3b)

Response: This series of comments refers to the Agency's use of a linear-non-threshold dose response model to estimate health effects for low dose rate, low-LET, radiation exposure, rather than one preferred by the commenter.

The linear-quadratic model was recommended in the NAS BEIR-3 report rather than the linear which was suggested to be an upper limit. The linear-quadratic model in BEIR-3 and NCRP64 appears to be based upon the initial site model for the theory of dual radiation action (TDRA).

This initial model is only one of several microdosimetric and/or biological models of dose-response (see Goodhead, D.T., Models of Radiation Inactivation and Mutagenesis, pp. 231-247 in Radiation Biology in Cancer Research, R.E. Meyn and H.R. Withers, editors, Raven Press, New York, 1980 for 11 models). Goodhead (op. cit. and An Assessment of the Role of Microdosimetry in Radiobiology, Rad. Res. 91:45-76, 1982) showed the inability of site model microdosimetry to explain observed experimental phenomena. For reasons given by Goodhead, it would be difficult to support the initial site model. A more general treatment of the TDRA is required to agree with experimental observations.

Newer models of radiocarcinogenesis are based on biological and carcinogenesis theory rather than physical microdosimetric theory. (D.T. Goodhead, An Assessment of the Role of Microdosimetry in Radiobiology, Rad. Res. 91:45-76, 1982; D.T. Goodhead, Models of Radiation Inactivation and Mutagenesis, pp. 231-247 in Radiation Biology in Cancer Research, R.E. Meyn and H. R. Withers, editors, Raven Press, New York, 1980; C.A. Tobias, et al., The Repair-Misrepair Model, pp. 195-230 in Radiation Biology in Cancer Research, R.E. Meyn and H.R. Withers, editors, Raven Press, New York, 1980; P.J. Walsh, Possible Effects of Division and Repair of Altered Cells on Dose Response Relationships in the Context of Carcinogenesis, Intern. J. Environ. Studies, 5:285-288, 1974; etc.). The inducibility of repair enzymes has been demonstrated (H. Tuschl, et al., Effects of Low-Dose Radiation on Repair Processes in Human Lymphocytes, Rad. Res. 81:1-9, 1980; G. Oliveri, et al., Adaptive Response of Human Lymphocytes to Low Concentrations of Radioactive Thymidine, Science 223:594-597, 1984). It has also been demonstrated that repair may be erroneous and increase the probability of malignant transformation (Office of Science and Technology Policy, Chemical Carcinogens; Notice of Review of the Science and Its Associated Principles, Federal Register 49, #100; 21594-21661, 1984; D.K. Myers, DNA Repair and the Assessment of Radiation Hazards, pp. 106-144 in Summary and Proceedings of a Biology Workshop on Biological Repair Mechanisms and Exposure Standards, ORA4/IEA 78-2(R), D. Billen, editor, Institute for Energy Analysis, Oak Ridge, 1978; M. Terzaghi and J.B. Little, Repair of Potentially Lethal Radiation Damage in Mammalian Cells Is Associated with Enhancement of Malignant Transformation, Nature 253:548-549, 1975). One interesting feature is that some of the models predict extrapolation from high to low dose will underestimate the risk (i.e., P.J. Walsh, 1974; D.K. Myers, 1978).

The BEIR-3 Committee considered only three models--linear, linear-quadratic, and quadratic--from among the possible models that might fit the dose response data. Several analyses have shown that the dose-response curve for breast and thyroid cancer is linear. Recently, Matsuura et al. (H. Matsuura et al., Pathological and Epidemiologic Study of Gastric Cancer in Atomic Bomb Survivors, Hiroshima and Nagasaki, 1959-77, J. Rad. Res. 25:111-129, 1984) reported that using T65 dosimetry the dose-response for stomach cancer is linear; both linear-quadratic and quadratic dose response are excluded. In the absence of human data for other radiogenic cancers, it may not be prudent to assume a less conservative dose response model. It should be noted, however, that both the linear and linear-quadratic dose response models have been used to estimate risks in the final Background Information Document (EPA-520/1-84-022-1). This allows a direct comparison of risk estimates based on differing scientific opinions.

Comment 2.2.1e: A recent article by Hickey, et al. in Health Physics discussed the problem of extrapolating from high dose data to risk at low doses and the inappropriateness of basing public policy on this practice. (P-18a)

Response: The article by Hickey, et al. while interesting is not an adequate basis to overthrow the current scientific consensus on cancer risk assessments. (See the Office of Science and Technology Policy on "Chemical Carcinogens: Notice of Review of the Science and Its Associated Principles," Federal Register 49: 21593-21661, 1984.) The principle espoused by Hickey, et al., Hormesis, has been observed to act only in mammalian studies where there was a high intercurrent infection rate, and the animals were sick. Sacher reviewed "radiation hormesis" in mammals and concluded, "These characteristics, together with those discussed above, lead to the conclusion that hormetic longevity effects generally have the form of a non-cumulative decrease of vulnerability that does not modify the aging process or the accumulation of irreparable radiation injury." (G.A. Sacher, Life Table Modification and Life Prolongation, pp. 582-638 in "Handbook of the Biology of Aging," C.E. Finch and L. Hayflick, editors. Van Nostrand Reinhold Co., N.Y. 1977) Sacher also pointed out that regardless of the presence of a "hormetic" effect, the proportion of animals developing tumors and the Gompeitz function ("force of mortality") slope of general mortality both show the expected dose related response at all dose levels, including the lowest exposure used. Since animals (or people) in a healthy robust state are not expected to show "hormesis" (T.D. Luckey, "Hormesis with Ionizing Radiation," CRC Press, Inc., Boca Raton, Florida, 1980) and the induction of cancer is not abated, it would not be prudent policy to allow unnecessary radiation exposure at any level.

Hickey, et al. also support their position with some reports of demographic epidemiology studies. This type of study is limited by the accuracy of estimation of exposure, lack of data on age-specific in- and out-migration, accuracy of diagnosis, etc. The BEIR-3 committee reviewed several of these studies on cancer and stated: "We conclude that these types of studies, depending as they do on death record data aggregated crudely by geographic region, do not constitute a sufficient basis for deciding whether one or another type of environmental factor, such as background radioactivity, is related to cancer rates. Thus, as a test of the effect on cancer risks of low-dose-rate lifetime exposure to radiation, this approach does not appear to be fruitful in the United States within the framework of variations in background-radiation exposure of populations large enough to provide data that would be statistically useful." ("The Effect on Populations of Exposure to Low Levels of Ionizing Radiation: 1980" (BEIR-3), National Academy Press, Washington, 1980)

Superimposed on the population size and exposure is the fact that one of the basic assumptions in a regression analysis of a demographic study is that those variables which are not included are randomly distributed with respect to the explanatory variables studied. Variables known to be correlated with cancer include age, sex, marital condition, race, birthplace, religion, ethnicity, socioeconomic status, and occupation (MacMahon, B. and Pugh, T.F., "Epidemiology: Principles and Methods," Little, Brown, and Company, Boston, 1970; Lilienfeld, A.M., Levin, M.L., and Kessler, I.I., "Cancer in the United States," Harvard University Press, Cambridge, Mass. 1972). Also influencing vital statistics will be in- and out-migration, age structure of migrants, and other demographic factors for which accuracy of data is limited or data is constantly being revised (see "The Methods and Materials of Demography" by H.S. Shryock, J.S. Siegel and Associates, condensed edition by E.G. Stockwell, Academic Press, N.Y., 1976).

While age-adjusting may compensate for differences in age, sex, and race between populations, other unidentified and unincluded variables may be of critical importance. As Lilienfeld, et al. pointed out (A.M. Lilienfeld, et al. Op. Cit. 1972), "In view of the long latent period which is presumed to be associated with the development of certain neoplasms, it is theoretically possible that factors of etiologic importance will be masked by the substantial migration of an 'already exposed' population into or out of a given geographic region."

For these and other reasons the Agency feels that prudent radiation protection still requires assumption of a linear-non-threshold model for induction of cancer and genetic effects at low levels of exposure.

Comment 2.2.1f: The EPA's risk assessment, based on BEIR-2 and UNSCEAR, understates the risks of chronic exposure to low levels of radiation. The analysis ignores the work of Elkind, MacMahon, and Morgan, which suggests that low doses have greater impacts than the linear extrapolations from high doses predict, and it also ignores the effects on radiosensitive populations such as children. Also, there is no evidence that the EPA considered cumulative or potential synergistic effects in its evaluation. (P-15a)

Response: The Agency believes the use of a linear dose response model without any dose rate reduction factor for low dose rate low-LET radiations is sufficiently conservative. While the Agency agrees with the NAS BEIR-3 Committee that a linear response is less conservative for high-LET radiations than for low-LET radiation, it is an adequate representation of our knowledge or numerical risk estimation at this time.

The EPA analysis includes age sensitivity to the same extent as the NAS BEIR-3 report. Although the NAS analysis for solid cancer dose does not consider the sensitivity of those of age ten or less to be as great as the NAS BEIR-1 report, increased probability of cancer induction during childhood is taken into account in the EPA analysis to the extent it was identified in the NAS BEIR-3 report. It is true that in general instances the Agency did not consider the cumulative effect of different sources in the same community or synergistic effects. In all of the cases examined, the principal source provided the vast majority of the estimated effect so that the contribution of minor sources was negligible compared to the uncertainty in the risk estimate. Moreover, the Agency is unaware of any scientific reports of synergism between radiation and toxic metals.

Comment 2.2.2a: In its discussion of health risk, the EPA fails to consider the BEIR-3 Report of 1980. The EPA has ignored the 1980 report by the National Academy of Sciences (BEIR-3). The EPA should have taken into account recent publications dealing with estimating the health hazards posed by radiation. These include the BEIR-3 report and NCRP 64. (G-2b, I-1b, I-1c, I-17, I-20a, I-31, I-32, P-1a, P-1b, P-9, P-18a)

Response: The Agency has updated the risk estimate for exposure to radionuclides given in the Background Information Document (EPA83). In doing so, we have used the age-dependent risk coefficients for a linear response given in the BEIR-3 report, "Effects on Populations of Exposure to Low-Levels of Ionizing Radiation." Our use of the BEIR-3 report for risk estimates is described in the Final BID where the Agency's choices between the various models proposed by the BEIR-3 Committee are examined in more detail than outlined in this response to comments.

To allow for an assumed lesser response for low-LET radiations at low doses and dose rates, the 1980 NAS BEIR Committee based its "preferred risk estimates" on a hypothetical linear-quadratic dose response function. The Committee made this choice after analytically examining the cancer mortality data and particularly the leukemia mortality data for A-bomb survivors on the basis of three dose response functions: linear, linear-quadratic, and quadratic. For reasons outlined in the final BID, the Agency believes only the first two of these functions are compatible with data on human cancer. Risk estimates for low-LET radiations in the final BID are based on the BEIR-3 linear and linear quadratic dose response models.

Although the majority of the members on the BEIR-3 Committee "preferred" a linear-quadratic response in 1980, we believe their quantitative basis for this judgment is considerably weaker now because of the subsequent reassessment of the A-bomb dosimetry. The Committee's analysis of dose response functions assumes that most of the observed excess leukemia (and solid cancer) among A-bomb survivors was due to neutrons (NAS80). Current evidence, however, is conclusive that neutrons were a minor component of the dose in both Hiroshima and Nagasaki (Bo82, RERF83a, RERF83b). Therefore, it is likely that the linear response observed among the A-bomb survivors, which the BEIR Committee largely attributed to neutrons, was, in fact, due to their gamma dose, not a dose of high-LET radiation (EPA84a).

Although there is evidence for a nonlinear response to low-LET radiations in some, but not all, studies of animal radiocarcinogenesis, the Agency is not aware of any data on human cancers that is incompatible with a simple linear model. In such a case, we believe it is preferable to adopt the simplest hypothesis that adequately models the observed radiation effect. Occam's razor is still a viable scientific rule for separating necessary from ad hoc assumptions. Moreover, EPA believes that risk estimates for the purpose of assessing radiation impacts on public health should be based on scientifically creditable risk models that are not likely to understate the risk. Given the current bias in the doses assigned to A-bomb survivors, such an approach seems particularly reasonable, as well as prudent.

The low dose rate effectiveness factors (DREF) developed by NCRP Committee 40 are based on their analysis of a large body of plant and animal data that showed reduced effects at low doses for a number of endpoints, including to a lesser extent radiogenic cancer in animals, chiefly rodents. However, no human data confirm these findings. A few human studies contradict them. Highly fractionated small doses to human breast tissue are apparently as carcinogenic as large acute doses (NAS80, La80). Furthermore, small acute doses (less than 10 rad) to the thyroid are as effective per rad as much larger doses in initiating thyroid cancer (UN77, NAS80). Moreover, the increased breast cancer due to chronic low dose occupational gamma ray exposures among British dial painters is comparable to, or larger, than expected on the basis of acute high dose exposures (Ba81). While none of these examples are persuasive by themselves, collectively they indicate that it may not be too prudent to estimate cancer risks due to low doses and low dose rates on the basis of observations at large doses. However, as pointed out in the final Background Information Document the BEIR-3 linear quadratic model, which we have also used to estimate risks, is equivalent to a DREF of 2.5, the same as that used by by ICRP and UNSCEAR.

All references refer to Chapter 8, Volume I of the Background Information Document (EPA 520/1-84-022-1).

Comment 2.2.2b: The risks predicted by BEIR-3 are less than those predicted by BEIR-2 by a factor of 2. More importantly, the report states that reported predictions are "average values per rad and are not to be taken as estimates at only 1 rad of dose." The committee only made predictions for . . . continuous exposures to 1 rad per year or more. To go from a 1 rad per year prediction to a 0.005 rem per year limit is not sensible. (I-20a, P-18a)

Response: This comment assumes that persons exposed to radionuclide emissions receive total doses as small as 0.005 rem per year. This is clearly impossible since normal background radiation from internal and external sources is at least 0.1 rem per year. The risk of interest is the incremental risk due to a change in the annual dose rate from, to use the commenter example, 0.1 to 0.105 rem per year. This is within an order of magnitude of the nominal 1 rad per year dose rates listed in the risk table prepared by the NAS BEIR-3 Committee. Morever, we note that the actual calculations made by that Committee to prepare these tables are based on a dose rate of 0.1 rem per year.

The Agency does not know of any human data on radiogenic cancer at low doses that is appreciably more consistent with a linear-quadratic dose response function than a simple linear response. Some data sets such as that for the radium dial painters do show a quadratic component at extremely high doses. In contrast, other studies, such as the one on U.S. uranium miners, show a reduced effect per unit dose in the high dose range. However, these perturbations occur at doses too large to be of regulatory concern. The Agency acknowledges that the shape of the dose response function for chronic exposures occurring in the range of environmental doses is unknown, and it has used both the linear and linear-quadratic dose response models. Moreover, it should be appreciated that the difference between the calculated risks using these two models, about 2.5, is smaller than the uncertainty in the risk estimates due to other factors.

Comment 2.2.3: The Committee should be aware that an October 1981 article in Health Physics has cast a cloud over all risk estimates based on the Hiroshima and Nagasaki data. A complete reanalysis of the dose curves has not, to the commenter's knowledge, been published, but any rule based on incomplete data is unconscionable. (P-18a)

Response: The Agency is aware of the 1981 Health Physics article and many other reports on the dose reassessment in Japan. Changes in the Japanese Atomic Bomb Survivor data base may require some adjustment of the risk estimates. This is discussed in the final BID.

Comment 2.2.4: The Federal Register does not mention Lucky's work on the possible beneficial aspects of ionizing radiation. (P-18a)

Response: See Comment 2.2.1d.

Comment 2.2.5a: No scientifically accepted epidemiological studies associate any increased risk to members of the public at levels of exposure associated with the various activities covered by the EPA's "Preliminary Report." (I-47)

Response: The commenter has confused the ability to prove or disprove a hypothesis with the validity of the hypothesis. Numerous reports have reviewed the basic requirements of epidemiologic studies of background radiation. In general, in addition to detailed demographic, socioeconomic, health statistics and exposure data across the time period involved, they require a base of millions to hundreds of millions of person-years of data to detect the incremental increase in risk projected by current risk coefficients, even for exposure levels around 4 times average background. Charles Land has examined this problem in some detail (C.E. Land, Science, 209: 1197-1203, 1980); see also: E.E. Pochin, Health Physics, 31: 148-151, 1976; S.G. Goss, Health Physics, 29: 715-721, 1975; C. Buck, Science, 129: 1357-1358, 1959; G. Hems, Brit. Med. J., 1: 393-396, 1966. None of the geographic epidemiology studies published to date have been able to meet the necessary criteria. This includes both negative and positive reports.

Many of the reports cited by the commenter fall into this category. For example, Dr. Lane's study was too small to detect any difference in health risk even if the risk were present. The power of this study to determine a carcinogenic effect, assuming one was present, is only 0.38, i.e., less than a 50-50 chance. Even though Lane calculated (incorrectly) a somewhat greater power, on page 34 of his thesis he states, "This is a relatively low power, however, and, consequently, a negative finding may be attributed to small sample size and should not be considered strong evidence for the null hypothesis of no association." Moreover, we do not believe that this study can be used to test EPA risk estimates. Using the radon daughter concentrations reported in his thesis, it has calculated, using the EPA risk models, what difference in lung cancer mortality due to radon might have occurred in his case and control groups for lifetime exposure. This difference was less than 0.2 cases, not a detectable amount in any epidemiological study, let alone one consisting of fewer than 100 participants.

The Kerala region of India has a population of about 70,000 with an estimated average exposure of about 342 mrem/yr, even though a small fraction (3105 persons) is exposed to 915 mrem/yr (C.M. Sunta, et al., TLD Survey of Natural Radiation Environmental Along the South-West Coast of India, Bhabha Atomic Research Centre, Bombay, 1978). While the commenter cites Gopal-Ayengar, et al. as showing no effects in Kerala, he does not mention positive reports by Kochupillai, et al. (N. Kochupillai, et al., Nature 262: 60-61, 1976) on increased congenital abnormalities, nor reproductive problems in 22 couples at about 20 times background (Sunta, et al. 1978).

Likewise, in the Brazilian study group, a 1970 report by Cullen, et al., is referenced but not a 1975 report by Costa-Ribeiro, et al. (C. Costa-Ribeiro, et al. Health Physics, 28: 225-232, 1975) showing increased chromosome aberrations in cytogenetic studies of lymphocytes of workers in a monazite plant. No reports on cancer incidence in the exposed Brazilian population are expected. A recent report by the Brazilian investigators (T. L. Cullen, et al. pp. 805-808 in Radiation Protection A Systematic Approach to Safety, 5th IRPA Congress, Pergamon Press, NY, 1980) concluded, "The lack of reliable medical practice and records renders an epidemiological study impractical."

Many of the other references cited involve demographic epidemiology or hormesis which were discussed in the response to Comment 2.2.1d.

Comment 2.2.5b: In a study conducted in China, a population of 74,000 people exposed to a high natural level of radiation was compared with a similar group whose dose was roughly 63 percent less (196 millirems versus 72 millirems). No significant differences in mortality, morbidity, or genetic damage were found. (I-3b, I-49)

Response: The commenter referenced the 1980 report of the High Background Radiation Research Group in China. This study was updated in 1981 (J. Radiat. Res. 22: 88-100, 1981). This update reported 383,653 person years and 418,265 person years in the cancer mortality study in the high-background and control groups, respectively. Since exposure in the high-background area was only about 3 times that in the control area, it should not be expected that an increase in radiation-related cancer would be demonstrated if present. Cytogenetic studies showed an increase in two-hit aberrations, the type one might expect to be associated with high-LET radiation, in the high-background study group. However, the total number of cases is small and the significance is not known.

About all that can be said of the high-background area studies is, they can't answer our questions. They do show EPA is not underestimating risk by orders of magnitude.

Comment 2.2.5c: It was stated earlier in the Denver hearings that the epidemiological studies done in Grand Junction by the Colorado Department of Health have not indicated that there is a bioeffect from exposure to the radiation levels observed. This is not a conclusion of the study. The latent period for the exposure levels experienced has not been exceeded. (G-24)

Response: The Agency agrees.

Comment 2.2.6: In considering such factors as radionuclide uptake by vegetation, and consumption of locally-produced crops and milk, has the EPA used conservative assumptions such as those developed by the Heidelberg Institute for Energy? (P-13b)

Response: EPA attempts to model environmental transport of radioactivity as realistically as possible; we make a best estimate of the expected environmental concentrations, all things considered. The Heidelberg Institute of Energy's assumptions, as indicated in the comment, are extremely conservative and serve to provide estimates which presume the maximum potential transfer at each step through the environment. One would expect the resulting estimates to far exceed those in an actual situation and hence be inappropriate to EPA assessments.

EPA used realistic assumptions for food pathways and uptake factors. The Agency did not use the values cited by the commenter because they are overly conservative.

Comment 2.2.7: Total body burden has been ignored in the assessment of risk (due to radon progeny). The reported risks are based on lung cancer alone. Sites such as bone and liver must also be included. In addition, pathways such as ingestion must be considered. (P-15b)

Response: The Agency considers all fatal cancers and hereditary risks in the assessment of radionuclide emission. In the case of inhaled radon-222, almost all of the risk, approximately 99 percent, is of radiogenic lung cancer. In such cases EPA does not the dose and risk to other organs, since their contribution to the total list risk is considerably less than the uncertainty in the estimated risk of lung cancer. It is true that radon decay progeny, principally lead-210, are deposited on vegetation and can reach men by the ingestion pathway, ultimately causing a dose to bone and liver. Again, this risk is unimportant relative to risk due to inhaling the daughters. The Agency explored this exposure route in detail in EPA 520/1-83-008-1, Final EIS for the Control of Byproduct Materials from Uranium Ore Processing. Typically the lifetime risk from the ingestion of radon products is one five hundredths of the risk due to the inhalation of radon progeny.

Comment 2.2.8: The EPA risk assessment understates risks by relying on 1970 census data. (P-15a)

Response: Increases in population since 1970 are small compared to the uncertainty in the risk estimates. More recent census data, not yet available, could show increased or decreased risks for a larger population, since estimates of population risk depend critically on the exact location of individuals within the region. The Agency believes it is sufficiently prudent to use currently available data.

Comment 2.2.9: The EPA's risk assessments could be made more realistic by including an estimate of the actual number of people exposed to various sources and by estimating risks for less than a 70 year continuous exposure. A series of assessments, using different assumptions about key uncertainties, would be preferable to the very conservative assessment made by the EPA. (I-53)

Response: Since atmospheric dispersion is not geographically bounded, the number of people actually exposed by releases from a source is only limited by the assessment area considered. For a regional population exposure estimate, EPA customarily considers exposures to individuals at distances within 80 km of a facility. The lifetime risk to an individual is a consistent starting point for the analysis. EPA is not suggesting that individuals customarily never move from a given spot for their entire lives but rather that such considerations are to be applied ex post facto to the extent that the expected risk to an individual may be made more realistic. Values of factors and parameters used in the assessments are intended to be reasonable estimates and are not values chosen to maximize the impact of a facility.

Comment 2.2.10: The proposed EPA standards are overly restrictive because they are based on hypothetical rather than real people. EPA's risk assessment is a worst case analysis, which is contrary to the requirements of the Clean Air Act. It deals with hypothetical individuals and upper limit estimates of carcinogenic risks. It should have included an analysis of comparative risks and margins of error. (I-1a, I-3a)

Response: The Agency has used reasonable parameters in the models used to assess risk. However, the Agency has not assumed that the current locations of housing relative to a given source will remain constant over time. New housing will continue to be built in areas where it is permitted. The magnitude of other risks does not affect the risk due to radionuclides. Therefore, the Agency's use of comparative risks is confined to the risk management process where a number of factors are considered in the decisions leading to an appropriate regulatory control level.

Comment 2.2.11: If EPA does not set standards based upon zero emissions, then standards should be based on worst case assumptions in the analysis. Although EPA appears to have used worst case assumptions in part of the analysis, they were not used consistently throughout the analysis. (P-3a)

Response: EPA tries to estimate the risk associated with emissions of radionuclides to air as accurately as it can. Worst case assumptions are not used throughout the analysis; rather, the Agency tries to use the most realistic ones. EPA has contracted with the Oak Ridge National Laboratory to develop the computer codes used to make risk estimates, committing very significant resources over long periods of time to this task. Nevertheless, it is recognized that the accuracy of these estimates is limited to about an order of magnitude, and this uncertainty is considered when proposing standards.

If worst case assumptions were used throughout an analysis, the results would be wildly inaccurate by many orders of magnitude. EPA would not have confidence in such results and believe most people would find them unsatisfactory.

Comment 2.2.12: The EPA should calculate doses based on an integration of the whole-body or organ dose to an individual over 80 rather than 70 years. Seventy years is based on average life expectancy, and is inappropriate, given current life expectancies, to protect the maximally exposed individual. (P-17)

Response: EPA believes that the use of a life table analysis yielding an average life expectancy of 70.7 years is appropriate for estimating the risk to large populations and to the maximum individual. The life table approach used to estimate dose and risk considers life spans out to 110 years.

Comment 2.2.13: The EPA's overly conservative assumptions and overly stringent standards are not warranted for regulating scientifically well-known substances. The EPA should explain why its methodology differs from radiation protection recommendations provided by the ICRP and NCRP. (I-3b)

Response: EPA does not believe it has used overly conservative assumptions (see response to Comment 2.2.9) or that it has proposed overly stringent standards.

The proposed standards were not overly strict just because they were lower than recommendations of the ICRP and NCRP of 500 mrem/y to the whole body and 1,500 mrem/y to an organ. Such levels of radiation exposure are generally recognized to represent a significant level of risk, especially if the exposure lasts for many years. Therefore, they are maximum permitted levels that should not be approached without good reasons, and people should not be exposed to such levels for any length of time. They do not represent an exposure level that provides, over a long term, an ample margin of safety for the public. Furthermore, they apply to the sum total of exposure to an individual such that occurs through all pathways and from all sources. They are not appropriate as limits for a single facility and a single pathway.

Comment 2.2.14a: The numerous assumptions involved in the AIRDOS-EPA and RADRISK models introduce uncertainties in the dose estimates that are larger than those arising from the errors of measurements. It would not be meaningful to propose a standard of 10 mrem per year to the whole body with the levels of uncertainties involved in the calculations of this value. (G-1b, P-1b)

Comment 2.2.14b: The codes specified are not site-specific and are extremely conservative, probably by at least an order of magnitude. Their technical validity should be validated by someone outside of EPA. (G-1a, G-1b)

Comment 2.2.14c: The mathematical codes that are required for calculation of the dose-equivalent values to the members of the public are controversial and not generally accepted by the scientific community. (G-1b, G-3)

Comment 2.2.14d: The EPA model does not account for wide variations in wind direction, velocity, and atmospheric stability caused by terrain and other factors affecting surface roughness. Nor does it account for the effect of particle size on transport dynamics. It therefore produces significant errors in estimated concentrations. (I-17, I-26)

Comment 2.2.14e: The AIRDOS-EPA model is inadequate because it appears to provide no means for calculating resuspended air concentrations or subsequent deposition to the ground surface. (P-2a, P-2b)

Response (Comments 2.2.14a through e): The original AIRDOS code was developed for the Department of Energy by the Oak Ridge National Laboratory who then made minor modifications to produce the version known as AIRDOS-EPA. The AIRDOS-EPA code can be made site-specific by using site-specific meteorology, population distributions, and food pathways factors. It has been reviewed by the Nuclear Regulatory Commission (NUREG-CR-3209, March 1983) who found no substantial deficiencies. The EPA considers that the codes represent the state of the art.

While it is true that the AIRDOS-EPA code does not directly account for the influences of terrain, the user-supplied meteorological data for his site will tend to reflect the influence of terrain upon the wind direction, velocity, and atmospheric stability. Moreover, the calculation of the dose to the maximum individual will not normally be influenced very much by the terrain, assuming he is reasonably close to the facility.

While AIRDOS-EPA does not explicitly include calculation of the resuspension of materials which have been dispersed and deposited on the ground surface, the effect of resuspension on inhalation may be approximated by simply ignoring deposition. A source of windblown activity (e.g., a gypsum tailings pile) may be assessed by determining the annual release and using the area source model in AIRDOS-EPA.

Comment 2.2.15: EPA, throughout its proposal, refers to risks of health effects as if they were proven or readily observable events. Such language is wrong and could be used to promote unwarranted legal actions. (G-2b, G-16, I-1b, I-31, I-32, I-40, I-47)

Response: There is some merit to the comment in that radiation effects at low doses are not readily observable. However, the BEIR Committee addressed this problem as follows: "Contrary to widespread belief, evaluation of the causal nature of an observed association is a statistical problem, and does not involve the concept of 'proof' in any definitive sense. The evaluation requires the assembly of information and concepts from many different sources and their integration into an overall estimate of the likelihood that an association is or is not causal. Where controversy exists, attention should primarily be focused not on whether the association is 'proven,' but on the limitations, the adequacy of data, the lack of design and corresponding artifacts, and finally the choice of the appropriate 'control' for the situation. In the process of assembly and integration of data, there may come a point at which it becomes - for the purpose of making decisions or taking actions of practical import - more prudent to act as though the association were causal, than to continue to regard it as non-causal. Where controversy exists, it should be focused on whether or not currently available data lead us to this point, rather than on the unanswerable question of whether the causal nature of the association is or is not 'proven.' It is important to recognize that both the evaluation of individual pieces of evidence and the relative weights assigned to evidence of different kinds contain substantial elements of subjectivity, and that there are few biological issues on which belief in the strength of the evidence of causality does not vary widely among experts in the field." (BEIR-1, pp. 93-94.)

In implementing the recommendations of the BEIR Committee, the "EPA Policy Statement on Relationship Between Radiation Dose and Effect, March 3, 1975" (pp. 143-145 in National Interim Primary Drinking Water Regulations, EPA-570/9-76-003), the Agency noted, "It is to be emphasized that this policy has been established for the purpose of estimating the potential human health impact of Agency actions regarding radiation protection, and that such estimates do not necessarily constitute identifiable health consequences."

The International Commission on Radiological Protection developed risk estimates similar to those in BEIR-1 and noted that the risk factors were intended to be realistic estimates of the effects of irradiation at low annual dose-equivalents (ICRP Publication No. 28, Report of the Stockholm Meeting, Ann. ICRP, 2, No. 1, 1979).

The current scientific consensus treats the estimated risks or potential health effects as real even though they cannot be demonstrated. While the uncertainty in the estimate is recognized, it would not be prudent to treat the estimated risk as unreal.

2.3 Control Technology

Comment 2.3.1: Where only a few individuals are at risk, EPA should consider whether the public health can be protected with an ample margin of safety through means other than the installation of extremely expensive emission controls. (I-42, I-53)

Response: The principal alternative to control technology is land use controls--keeping people away from the point of emission. As a last resort, EPA suggested land controls for uranium mines to reduce risks from radon because control technology was not available. Commenters stated that land use controls are impractical for uranium mines, and it was partially for this reason the proposed standard was withdrawn.

Comment 2.3.2: In identifying best available technology (BAT), EPA should focus on technology that has been adequately demonstrated at a commercial scale plant for the source category on which the control requirement is to be imposed. (I-42)

Response: In determining available technology for a source category, the adequate demonstration of the technology at a commercial scale facility with similar emission characteristics is a major criterion in the EPA's evaluation of applicable controls.

2.4 Proposed Limits

Comment 2.4.1a: The application of ALARA at 10 mrem/yr is troublesome because it is close to the levels most people consider de minimis. (P-1b)

Comment 2.4.1b: In view of the estimates of dose and risk and the projected limited growth for some types of facilities, it hardly seems necessary at this time to drastically reduce radiation dose limits. (P-1b)

Comment 2.4.1c: The 10 mrem/yr limit is too restrictive, borders on insignificance, and cannot be measured against existing background levels. (I-36a, I-36b, I-50, P-1b)

Comment 2.4.1d: The proposed standard of 10 mrem/yr is not practical, reasonable, or enforceable. It is about 1.1 microrads per hour, very close to the detection limit. This includes the ability to discriminate by measurement from the background. (G-1b, G-24, P-1b)

Comment 2.4.1e: EPA proposed 10 mrem/yr standards are far below any reasonable limit for the maximally exposed individual. (I-3a)

Response (Comments 2.4.1a through e): For various reasons, many commenters consider the proposed standards too strict; in particular, a 10 mrem/y unit for any organ for all licensed facilities, and a 10 mrem/y unit for whole body for DOE facilities is considered by some too restrictive. These comments are no longer applicable because the proposed standard is withdrawn.

Responses to other parts of these comments are given elsewhere:

a. Need for the Standards - See response to Comment 2.1.2.

b. Evaluation by Comparison with Natural Background - See response to Comment 2.1.11.

c. Enforcement and Detection Limits - See response to Comments in Section 2.5.

Comment 2.4.2a: The proposed indirect standards should be upper limits that also consider other sources and background concentrations. (G-24, P-15a)

Comment 2.4.2b: The proposed standards do not provide the level of health protection required by the Clean Air Act. (P-15a)

Comment 2.4.2c: We recommend that the EPA establish a generic dose limit of 10 mrem/yr to any individual from any type of facility, with the continued use of the ALARA concept to keep dose as far below this limit as possible. (G-17, G-21)

Comment 2.4.2d: The intent of Congress was that EPA establish zero emissions standards. (P-3a)

Comment 2.4.2e: The EPA should propose limits that reduce the risk to as close to zero as possible. (P-2a, P-2b)

Response (Comments 2.4.2a through e): Many commenters do not consider the proposed standards to provide enough protection.

EPA has concluded present practices are protective of public health with an ample margin of safety. For Federally licensed facilities and Federally owned facilities, "ALARA" is required by Federal Guidance established by the Federal Radiation Council and still in effect.

For reply to the question of whether the standards are not strict enough unless they require zero emissions, see response to Comment 2.1.5.

Comment 2.4.3a: If indirect standards are to be used, they should be met at the facility property line. (G-24, P-36, P-17)

Comment 2.4.3b: The standard should apply to normally occupied areas, not necessarily the site boundary. (I-8a, I-8b)

Comment 2.4.3c: Under the CAA, risk must be based on reasonably probable risk to average persons, accounting for sensitive population subsets, rather than hypothetically maximally exposed individuals. (I-3b)

Response (Comments 2.4.3a through c): Commenters question the location where the standards should apply.

EPA carefully considered the question of where the standards should apply, that is, to individuals assumed to live at the site boundary or to individuals where they normally live, the actual residence. Most facilities have people living so near the property lines that whether they are assumed to live directly on the line or a few hundred feet away makes no practical difference.

A facility in a truly remote area may have no one living near its boundaries. If there is no reason to prevent people living there, it is somewhat foolhardy to assume no one will move into this area, and controls should be based on this assumption. For this reason, facilities usually use emission controls designed under the assumption that someone is living very near their site boundary.

Comment 2.4.4a: DOD, DOE, and other facilities have some potential for accidental releases that exceed the proposed standards. Because these are not specifically exempted, litigation seriously affecting the nuclear weapons program without benefiting the public could result. (G-16)

Comment 2.4.4b: The proposed limit is so low for NRC facilities it does not allow for any accidental releases due to personnel or process errors. (I-37a)

Response (Comments 2.4.4a and b): Commenters imply that "accidental" releases should be exempted from any standards. EPA carefully considered this question but did not to exempt accidental releases from the proposed standards for the following reasons:

a. The difference between an "accidental" release and releases due to bad planning is often difficult to determine. An exemption thus would make implementation difficult and more complex, giving the impression of a "loophole."

b. Accidental releases of a magnitude sufficient to violate the proposed standards are extremely rare. There seems to be no need to make specific allowance for them.

c. Including "accidental" releases with the emission limit encourages good practice to prevent "accidental" releases.

2.5 Implementation

EPA received the following comments with respect to implementation of final rules. They are no longer applicable because the proposed standards have been withdrawn.

Comment 2.5.1: It is not clear:

a. how EPA proposes that the standards be enforced;

b. what the enforcement costs would be; and

c. how enforcement by the states and particularly the radiation control programs would be funded.

(G-23, I-34)

Comment 2.5.2: It is essential that EPA conduct surveillance of releases of radionuclides from the DOE and NRC plants. The DOE and its predecessor, the AEC, have histories of under-reporting releases. The EPA must be able to survey, conduct investigations, and carry out enforcement actions without interference. (P-13b)

Comment 2.5.3: We object to measuring emission compliance at a fence line by using a model that fails to take into account local terrain and meteorology and is not based on actual measurements. (P-15b)

Comment 2.5.4a: The required use of the EPA computer code is troublesome because many sites have their own codes that incorporate what they know of their area. Uncertainty should be taken into account, not avoided. (I-50, P-1b)

Comment 2.5.4b: The proposed EPA standards may require substantial revisions to existing models used by licensees to assure compliance with existing standards. (I-1a)

Comment 2.5.5: Controlling dose levels by reliance on a single code to determine dose is not desirable. Means should be found to permit compliance via environmental measurements. (G-23, P-1b)

Comment 2.5.6: No indication is given concerning the type of quality control programs (for AIRDOS-EPA and RADRISK) required to assure reliable dose calculations on the basis of emissions and environmental conditions for many different facilities and locales. (P-1b)

Comment 2.5.7: The proposed limits are so low that there is essentially no practical way to measure whether facilities are in compliance. State-of-the-art monitoring techniques cannot distinguish between normal fluctuations in natural background radiation and the extremely low levels permitted by the proposed standards. (G-1a, G-1b, G-2b, P-1b, P-9, I-17, I-19, I-49)

Comment 2.5.8: AIRDOS-EPA incorrectly calculates doses over hilly terrain. The model also does not take into account releases from short stacks or vents; a majority of the NRC and Agreement States licensees release in this manner. Due to these shortcomings the model's use should not be mandatory. (P-1a, P-1b)

Comment 2.5.9: The Act requires the EPA to mandate source monitoring to demonstrate that the standards are being met. (P-15a)

Comment 2.5.10: We believe that the proposed limits should provide, at a minimum, adequate provisions for monitoring radionuclide burdens in carnivorous teleosts and avian raptors within 80 km of an identified point source, with the 10 mrem/yr. limit applied to these species until a wildlife standard is developed. (G-19)

Comment 2.5.11: A sensitivity and robustness analysis, as recommended by ICRP-29, should be made of the models the EPA is relying on to demonstrate compliance. (G-20)

2.6 Cost

EPA received the following comments with respect to implementation of final rules. They are no longer applicable because the proposed standards have been withdrawn.

Comment 2.6.1: Attempts to unnecessarily restrict emissions, establish ALARA standards, or impose additional standards on already regulated facilities, when doses are already minimal, can only result in unnecessary expense in attempting to demonstrate compliance. (I-1b)

Comment 2.6.2: An emission standard reflecting BAT should not be imposed if the existing health risk is insignificant. High cost incremental emission reductions that do not significantly reduce health risks should not be required. (I-42, I-53, P-1b)

Comment 2.6.3a: It is not clear that the total cost of the proposed regulations will be less than $100 million. Therefore, a cost-benefit analysis must be performed as required by Executive Order 12291, February 19, 1981. (I-2a, I-2d, P-1a, P-1b)

Comment 2.6.3b: The proposed standards do not require an economic analysis under Executive Order 12291 for the following reasons:

1. The total annual cost will be less than $100 million.

2. The proposed standards were issued under a court-ordered deadline and are thus exempt under Section 8(a)(2) of the Executive Order.

3. The Executive Order can apply only to regulations "to the extent permitted by law." For Section 112, Congress has explicitly rejected the notion that economic considerations must be given highest priority.

(P-3b)

Comment 2.6.4: Unnecessarily restrictive practices are inhibitory and set the United States at a competitive disadvantage. (P-1b)

Comment 2.6.5: While the EPA clearly has the discretion to consider cost, it has failed to adequately consider economic cost in the proposed rulemaking. The cost for each health effect averted is $250 million for elemental phosphorus and $10 million for underground uranium mines. This is unreasonable. In its development of radiation protection standards, the EPA has indicated that between $250 and $500 thousand per health effect averted is a reasonable regulatory cost. (I-3b, I-53)

Comment 2.6.6: The EPA's task is to reduce, not eliminate risk. If affected industries can not economically survive under the proposed rules, the rules should be relaxed. (P-19)

Comment 2.6.7: A cost-benefit analysis, including an evaluation of the improvement in public health resulting from the proposed standards, should be performed. (I-1a)

2.7 Other Comments

Comment 2.7.1: The definition of "dose to an individual" in terms of a dose rate (48 FR 15076, 15077) is incorrect. The Agency avoids this error in the proposed regulations, and should correct the supplementary information accompanying the final rule. (P-3b)

Response: EPA agrees.

Comment 2.7.2: The EPA should consider developing standards for indoor radon exposure. (G-23)

Response: Standards for indoor radon exposure would be outside the scope of this rulemaking because virtually all of this radon results from naturally occurring sources.

Comment 2.7.3: The proposed NRC standards do not cover naturally occurring or accelerator produced materials licensed by state agencies. These materials should be covered. (G-23)

Response: EPA examined naturally occurring radionuclides in a number of source categories and made decisions on the need for a standard for each category. EPA did not consider the users of accelerator produced materials; consequently, no standard was proposed for this group, and no decision was made not to propose a standard.

Comment 2.7.4: The proposed rule states that industrial gauges, static eliminators, radiographic devices, self-illuminating watches, and smoke detectors involving production of sealed sources do not emit radionuclides. At the end of their useful lives these devices, particularly smoke detectors containing americium or radium, will find their way to landfills or incinerators. (P-21)

Response: These sealed source devices do not present the potential for airborne release during their operating lives. At the end of their useful lives, licensed sources such as industrial gauges and radiographic devices will be disposed of at licensed disposal sites with no potential for airborne release. Smoke detectors are and are likely to continue to be disposed of in commercial landfills and incinerators even though the directions specify that they be returned to the manufacturer for disposal at a licensed facility. A typical detector for home use contains approximately 1 microcurie of 241 americium. Commercial detectors contain about 15 microcuries. Tests of such detectors show a few hundredths to a few tenths of percent of the americium could be released after incineration at 2000°F for four hours. Thus, the EPA concludes that such devices do not pose a significant threat of airborne release even if incinerated at the end of their useful lives. (For more details see NUREG/CP-001, Radioactivity in Consumer Products, U.S. Nuclear Regulatory Commission, Washington, D.C., August 1978, pp 434-440.)

Comment 2.7.5: Page 15078, second column, E-3, the 1st line is a misquote of the FRC recommendations. The RPG is 500 mrem/yr. As an operational technique, it can be assumed that the average of a critical group is one-third of the maximum. Thus, if the average of the critical group is 170 mrem/yr, it can be assumed that the RPG of 500 mrem/yr is met. (P-1b)

Response: The commenter has slightly misstated the FRC guidance. The guide is, as stated, 0.5 rem/year when the individual whole body doses are known. Where individual whole body doses are not known, a suitable sample of the exposed population should be developed. The guide for the sample population is 0.17 rem/capita/year.

Comment 2.7.6: Page 15079, first column, last paragraph. It is not possible to compare impacts of sources at different places from the maximum individual dose. The total impact depends upon the characteristics of the source and the distribution of the population around the source. (P-1b)

Response: The location of the maximum exposed individual in EPA's assessments is the point of maximum off-site risk for the particular source. Thus, the risk to maximally exposed individuals is directly comparable from source to source. The total impact of the source does, as noted, depend on the characteristics of the source and the distribution of the population around the source. EPA's analyses account for population distribution, and the selection of the site parameters used in each assessment is made to assure that the health risk assessment is representative of the source category.

3.0 DOE FACILITIES

3.1 Basis for the Standard

Comment 3.1.1: To provide protection from long-lived radionuclides, the EPA should promulgate a cumulative population dose standard as well as an individual dose standard. Contrary to the EPA's assertion that setting emission limits to the general population would serve no useful purpose, its analysis of population doses and risks from krypton-85, carbon-14, and iodine-129 shows such doses can be significant from even a single year's release. Had the cumulative impacts over the thousands of years long-lived radionuclides remain hazardous been considered, the need for a cumulative population dose would be even more readily apparent. (P-3b, P-17)

Response: EPA considered proposing a population as well as an individual dose limit, but decided against it. Doses and risks to populations within 80 km of all DOE facilities due to long halflife radionuclides are low. Additional control technology is not practical or effective. Emissions are not likely to increase in the future. EPA did analyze cumulative impacts over very long periods of time and worldwide; these impacts were also small. (See BID page 2.26-1). The Agency concluded that a limit on population dose is not needed.

Comment 3.1.2: New radionuclide emission standards under Section 112 of the Clean Air Act are not needed. The DOE's implementation of the current standard of 500 mrem/yr., together with the ALARA principle, protects the public health with an adequate margin of safety. This is demonstrated by the EPA's own estimates of radiation dose and health effects from operation of DOE facilities. (G-1a, G-1b)

Response: EPA does not believe that current Federal Radiation Council guidance and NRC policy of limiting exposure to individuals to 500 mrem/y whole body and 1500 mrem/y to any organ protects public health with an ample margin of safety, as required by the Clean Air Act. EPA estimates that a person receiving 500 mrem/y to the whole body over a lifetime would have an added potential fatal cancer risk of about 1 in 100 due to the radiation exposure. In addition, that same person would face an approximately equal level of risk of nonfatal cancer and of passing on nonfatal genetic effects to succeeding generations.

However, EPA recognizes that an "as low as reasonably achievable" (ALARA) emissions policy has led to generally low emissions of radionuclides from most facilities. The risks associated with these emissions are often insignificant. The Agency expects that this current policy will continue in the future and does not anticipate an increase in the emission levels or the associated risks. Therefore, the Agency believes that where a vigorous and well-implemented ALARA program has achieved low emissions, such practice can provide an ample margin of safety for public health protection.

Comment 3.1.3: The EPA's estimate of the level of risk associated with existing operations at DOE facilities is lower than its estimate of the risk associated with uranium fuel cycle facilities. Yet the EPA does not propose to regulate uranium fuel cycle facilities under Section 112 of the Clean Air Act, apparently concluding that 40 CFR 190 provides an ample margin of safety. In effect, the DOE is being punished for an effective ALARA program. (G-1a, G-1b)

Response: This comment is no longer applicable in that EPA does not intend to regulate DOE facilities or uranium fuel cycle facilities under the Clean Air Act.

Comment 3.1.4: The EPA's rationale for the proposed standards for DOE facilities, that they can be met at a cost that the EPA deems justifiable, is arbitrary. It is not based on new scientific evidence and is inconsistent with the EPA's rationale for excluding other sources from standards, that is, that the benefits do not justify the costs. (G-1a, G-1b)

Response: EPA did not propose the emission limits for DOE facilities primarily on the basis of cost. EPA considered individual and population risks, potential for significant emissions, cost and availability of control technology, and the applicability of other emission limits already in force. Costs were considered to a limited extent (see response to Comment 2.1.7) because it would not be reasonable to do otherwise.

A strict cost-benefit rationale would require the risks to large population groups to be balanced against the cost of control technology. This approach was not used because Section 112 of the Clean Air Act requires protection of public health with an ample margin of safety and for other reasons (see response to Comment 2.1.7). A cost-benefit rationale was not used by EPA to justify its determinations against proposing standards for certain sources (48 FR 15096).

EPA has decided to withdraw the proposed standards (48 F.R. 15076) based on its determination that current practice provides an ample margin to protect the public health from the hazards associated with exposure to airborne radionuclides from this source category.

3.2 Dose and Risk Calculations

Comment 3.2.1: At the fifteen DOE facilities considered to provide a dose less than 1 mrem/yr, was the surveillance carried out by EPA? If it was not carried out by EPA, I consider it unacceptable. (P-13b)

Response: The source terms for all of our assessments of DOE facilities are based on monitoring conducted by the facilities. The EPA has a high degree of confidence in the reliability of these data and the integrity of the personnel responsible for them.

3.3 Control Technology

Comment 3.3.1: The EPA has not even considered the availability of control technologies to reduce such long-lived radionuclides as tritium, carbon-14, etc. Such controls are available and should be required. (P-17)

Response: The EPA did consider the availability of control technologies to reduce long-lived radionuclides emitted from DOE facilities. ("Control Technology for Radioactive Emissions to the Atmosphere at U.S. Department of Energy Facilities," PNL 4621, prepared for the U.S. Environmental Protection Agency by Pacific Northwest Laboratory, Richland, Washington). As stated in 48 FR 15076, the Agency considered as an alternative to the proposed standard, emission limits for long-lived radionuclides. Such an approach was rejected due to the small population doses caused by such emissions and the unavailability of effective control technologies for tritium which is responsible for the highest of these small population doses.

3.4 Proposed Limits

Comment 3.4.1: The proposed limits are twice as high as the NRC standard for airborne emissions from nuclear power plants (10 CFR 50, Appendix 1), and are grossly inadequate to meet the requirements of the CAA which requires technology-forcing standards. (P-17)

Response: The Clean Air Act does not necessarily require technology-forcing standards. EPA considers requiring technology-forcing control technology when the risks remaining after the application of best available technology are significantly high. This is not the case for DOE facilities. When available technology is used, emissions from DOE facilities are small and the residual risks both to individuals and populations are also small. The control technology currently used and the application of other ALAP procedures at DOE facilities have resulted in emissions such that an ample margin of safety is provided. The NRC requirement cited by the comment (10 CFR 50, Appendix I) is not an emission standard but rather a design goal.

Comment 3.4.2a: In 48 FR 15076, p. 15081, the EPA requests comments on setting different limits for different DOE facilities. We oppose any such distinction; the limit for the highest DOE facility should be the limit for all DOE facilities. (P-16).

Comment 3.4.2b: The EPA should propose separate limits for each type of DOE facility. This is consistent with what was done under 40 CFR 190. (P-17)

Response (Comments 3.4.2a and b): EPA carefully reconsidered the need for separate limits for different groups of DOE facilities.

However, EPA has decided to withdraw the proposed standards based on its determination that current practice provides an ample margin to protect the pubic health.

Comment 3.4.3: The radionuclide emission standards proposed by EPA are too stringent, and are not consistent with EPA's standards for other radiation-releasing activities in the United States. (G-1a, G-1b)

Response: EPA has decided to withdraw the proposed standards based on its determination that current practice provides an ample margin to protect the public health from the risks associated with exposure to airborne radionuclides from this source category.

Comment 3.4.4: The EPA's proposed 10 mrem/yr whole-body dose limit for DOE facilities, based on available and reasonable control technologies, is laudable. (G-21)

Response: See response to Comment 3.4.3.

3.5. Implementation

EPA received the following comments with respect to implementation of the final rules. They are no longer applicable because the proposed standards have been withdrawn.

Comment 3.5.1: The permitting and paperwork requirements of 40 CFR Part 61, Subpart K, are excessive. They will be time consuming, costly, and will hamper research programs. (G-1a, G-1b, G-3)

Comment 3.5.2: The requirement that prior permits be obtained before any modification of the source is totally impractical for the experimentally flexible, distributed service nature of the DOE facilities. (G-3)

Comment 3.5.3: For locations where uranium is the critical exposure radionuclide, the EPA must specify the calculational approach and sampling requirements for determining particle sizes and solubility. (P-1b)

Comment 3.5.4: The EPA must specify compliance monitoring as required by the Act. (P-15a)

Comment 3.5.5: The DOE will need four years to complete modifications at one or more facilities; thus, it cannot meet the fall 1985 implementation deadline. (G-1a, G-1b)

3.6 Costs

EPA received the following comments with respect to implementation of the final rules. Most are no longer applicable because the proposed standards have been withdrawn.

Comment 3.6.1: The reduction of an already miniscule risk achieved by expending $25 million (EPA's estimate) at DOE facilities is clearly cost ineffective and directly contravenes the requirements of Executive Order 12291. (G-1b)

Response: Before withdrawing the proposed standards, EPA considered the costs of other alternatives. We estimate the annualized cost of promulgating the proposed standards to be about $500,000. To promulgate standards 2.5 times higher than the proposed standards, the annualized cost was about $50,000. These costs are based on recent studies for EPA by Pacific Northwest Laboratories ("Control Technology for Radioactive Emissions to the Atmosphere at U.S. Department of Energy Facilities," Battelle, PNL-4620 (Final), October 1984).

Comment 3.6.2: The $25 million cost estimate made by EPA does not include such direct costs as complying if increased production activities are required, costs of shutdowns if it is not possible to comply, or the costs of assuring compliance without exception for an unusual occurrence or an accidental release. (G-1b)

Comment 3.6.3: The reductions in risks obtained by the proposed standard, assuming we can measure incremental doses of 10 mrem/yr, are in no way justified by the costs. Using the EPA's estimates, population doses would be reduced by 4 person-rems/yr at a cost of $25 million, or $1.7 billion/health effect averted. (P-1b)

Comment 3.6.4: Preliminary DOE estimates of the costs for improved monitoring, facility modifications, and increased manpower for monitoring and reporting greatly exceed the $25 million that the EPA has estimated. (G-1a, G-1b)

Comment 3.6.5: The EPA has failed to perform a cost-benefit analysis for the proposed standards, or the alternative regulatory actions. (G-1a, G-1b)

3.7 Other Comments

Comment 3.7.1: The EPA has not provided for accidental releases in the proposed standards, making it virtually impossible to guarantee that the very low limits will never be exceeded. (G-1a, G-1b)

Response: EPA did not exclude accidental releases from the proposed rules. However, this point is now moot since EPA has withdrawn the proposed rules.

Comment 3.7.2: Remedial action sites, accidental releases, and releases regulated under 40 CFR 191 should be exempt. (G-3)

Response: See response to Comment 3.4.3.

4.0 NRC-LICENSED FACILITIES AND NON-DOE FEDERAL FACILITIES

4.1 Basis for the Standard

Comment 4.1.1: It would be preferable to regulate only certain categories of NRC and Agreement State licensees under Section 112. The remainder should be regulated under Section 111. In addition, it is not clear if facilities which are licensed to only use sealed sources are included in 40 CFR 61.130. (I-49a)

Response: EPA has decided to withdraw the proposed standards based on its determination that current practice protects the public health with an ample margin from risks associated with airborne radionuclides from this source category.

Comment 4.1.2: The EPA should consider the risks posed by emissions from NRC facilities in relationship to the risks from natural background radiation and other risks normally experienced in life in developing its standards. (G-2a, G-2b)

Response: EPA recognized that the risks associated with emissions of radionuclides from NRC facilities were less than the risk associated with background radiation when standards were proposed. Also, see the response to Comment 2.1.11.

Comment 4.1.3a: The public health rationale for setting additional airborne emission limits on NRC-licensed facilities is absent. If there is no demonstrable public health benefit, then there is no need for the standard. (G-2b)

Comment 4.1.3b: The EPA has not demonstrated that the current NRC regulations do not adequately protect the public; therefore, there is no need for the EPA rule. Moreover, dual regulation by the EPA and the NRC is not warranted and is discouraged under Section 122(e)(2) of the Clean Air Act. (G-2a, G-2b, G-3, G-16, I-17, I-32, I-33a, P-9)

Comment 4.1.3c: The EPA evaluation indicates that emissions from NRC-regulated activities are already as low as reasonably achievable. The EPA should therefore find that the regulations in 10 CFR Part 20 are adequate and not promulgate National Emission Limitations for NRC-licensed activities. (G-2b, I-3b)

Response (Comments 4.1.3a through c): See response to Comment 4.1.1.

Comment 4.1.4: The EPA has rejected a more liberal standard because the proposed standard is currently being met by all facilities in this group. If this is actually the case, then under the EPA's "factor analysis" there is no need for the proposed standards. (G-3, I-49a)

Response: See response to Comment 4.1.1.

Comment 4.1.5a: The EPA has demonstrated that current levels of emissions are so low that additional control is not warranted but has not demonstrated that there will be future potential for large releases. Nor is there any reason to expect that NRC controls will not prevent an increase in risk over the present level. (G-2b)

Comment 4.1.5b: The fact that all licensees appear to be meeting the standard is not of itself justification for the standard, and the standard could pose unnecessary restrictions on future operations. (I-31, I-40)

Response (Comments 4.1.5a and b): The fact that several comments state that the standard could restrict future operations indicates that there is a potential for emissions to increase in the absence of a standard, even with NRC controls in place. However, EPA does not believe this will occur, given NRC's ALARA programs.

Comment 4.1.6: The origin of the 10 mrem/year limit to any organ is not given; nor is the term "living nearby" defined. (I-8a)

Response: The proposed numerical limit has been withdrawn. The proposed rule was intended to apply to the dose equivalent received by any member of the public (regardless of whether they "live nearby").

Comment 4.1.7a: The EPA's assessment of NRC-licensed facilities examines only a small number of facilities in only two of the many categories of facilities licensed and regulated by the NRC. The EPA should analyze other classes of licensees, such as plutonium fuel fabricators, research facilities, and scrap processors. (G-2a, G-2b)

Comment 4.1.7b: The EPA did not mention radiochemical producers in its background document. Larger releases from these operations are likely. Nor did it note that raw materials licensees may not be able to meet the proposed standard. (I-31, I-40)

Comment 4.1.7c: The EPA has unlawfully deprived raw materials licensees of their right to supply meaningful comments on the proposed limits by either failing to disclose the relevant data used to arrive at its decision or by overlooking those licensees and thereby proceeding on the basis of inadequate data. (I-47)

Response (Comments 4.1.7a through c): Section 3 of the Background Information Document includes risk evaluations of four categories of facilities licensed and regulated by the NRC and/or the Agreement States: research and test reactors, radiopharmaceutical manufacturers, radiopharmaceutical users (hospitals), and radiation source manufacturers. Previous screening analyses indicate that the facilities in these four categories have the greatest potential radiological impacts of all of the facilities mentioned by the commenter. Research facilities, given the quantities of material handled and the effluent control systems used, do not have the potential for releasing substantial quantities of radionuclides into the air. Previous analyses also indicate that emissions from plutonium fuel fabricators (during periods when such facilities were operated) were adequately controlled. The EPA believes that future activities at these facilities can be conducted within an ample margin of safety for protection of the public health. The third category identified by the commenter, scrap processing, is carried out by fuel fabricators as part of the uranium fuel fabrication process. Thus, these scrap processing facilities are part of the uranium fuel cycle, and their emissions are already regulated under the limits established by 40 CFR 190.

The number of facilities examined in the analyses in Section 3, while small, is sufficient to assure that the models used to estimate the airborne emissions and risks for each of the source categories are indicative of actual risks from real facilities. Examining larger numbers of facilities would not have added materially to the analyses, particularly as most of the roughly 7500 NRC-licensed and 12,500 Agreement States-licensed facilities covered by the proposed rule use only small quantities of licensed material, much of it in sealed sources. The radioactive materials possessed by such licensees do not have the potential for causing substantial airborne effluents or impacts.

EPA is not aware of any substantial differences between radiochemical producers and radiopharmaceutical producers. EPA's analysis of the industry covered the production of both. See Table 3.3-1 of the Background Information Document.

It is not clear what the term "raw materials licensees" means. EPA assumes it refers to facilities which process or use "source material" (material which has a uranium or thorium content greater than 0.05 percent by weight). Facilities which process source material as a part of the uranium fuel cycle are already regulated by the EPA under Title 40 of the Code of Federal Regulations, Part 190. There are other processors of source materials (notably the producers of rare earths and metals such as columbium and tantalum) which were not covered in the original Background Information Document.

All of the data on which the proposed rule was based was in the public record at the time of proposal. The record did not contain emissions data from every single NRC licensee or on every conceivable subcategory of licensees. EPA does not agree that this constitutes inadequate data or that anyone subject to the proposed rule has been denied the right to supply meaningful comments. Indeed, the person submitting this comment also submitted extensive additional comments on the proposal.

Comment 4.1.8a: The NRC limit of 500 mrem/yr (170 mrem/yr) when sizable populations are involved, is being met by the NRC and Agreement State licensees. This limit conforms with the recommendations of national and international scientific organizations and has been determined to be adequate to protect the public health and safety. (I-19, I-37a, I-38)

Comment 4.1.8b: The proposed 10 mrem/yr dose to any organ is a 300-fold decrease from the current standard. Yet, no data supporting such a reduction are presented in either the FR notice or the BID. (I-19, I-30, I-37a)

Response (Comments 4.1.8a and b): See response to Comment 3.1.2.

Comment 4.1.9: There is no health justification given for the 10 mrem/yr organ dose limit. The EPA does not cite any study which detects any increase in adverse health effects in populations exposed to levels of radiation above average background, and we do not believe any credible evidence exists that indicates increased cancer incidence at exposures below 10 mrem/yr whole body. (I-19)

Response: EPA is not aware of any study which conclusively proves that increased cancer incidence does or does not occur at exposures of about 10 mrem/y. In the absence of such proof, EPA has chosen to assume a linear, non-threshold relationship to predict the risk of fatal cancer associated with exposure to radiation. Under this assumption, any radiation dose is assumed to pose some risk of damage to health. EPA believes this assumption is reasonable in light of presently available information. See also Comment 2.25.

Comment 4.1.10: The EPA appears to have selected the proposed limit on the basis that it would be easy to meet and would not require excessive expenditures for controls. This has not been documented, and licensees already use controls to meet the NRC's 500 mrem/yr limit. (I-19)

Response: Nowhere in the record has any facility that could not meet the proposed standard been identified. Facilities that use currently available control technology are operating very far below NRC's 500 mrem/y limit.

4.2 Dose and Risk Calculations

Comment 4.2.1: It is not clear what dose conversion factors were used in the analysis. (I-18)

Response: Individual dose conversion factors were not inserted into the docket because of the large volume of data involved. Single valued dose conversion factors are not used by the RADRISK code which requires time dependent doses for the life table calculation. Dose models used are essentially those of ICRP-30. While the Agency can supply intermediate data for specific nuclides, a complete set of risk estimates for lifetime exposure to approximately 150 of the most commonly occurring radionuclides are found in reference (Su81) of Volume 1 of the Background Information Document.

The dose conversion factors were not given explicitly in the original analysis, but their basis is now described in detail in Volume 1 of the Background Information Document.

Comment 4.2.2: The EPA has not provided sufficiently detailed information on its derivation of risk, particularly with respect to organs exposed due to internal deposition of radionuclides. (G-2a, G-2b)

Response: The Agency has revised its estimates of radiation induced risks in light of the 1980 BEIR-3 report. As part of this revision, risks to particular organs have been explicitly considered.

Comment 4.2.3: The EPA uses risk coefficients (e.g., the pulmonary weighting factor for the lung) which differ from the coefficients recommended by ICRP-26, and also from those used in its own proposed guidance for occupational exposure. (G-2a, G-2b)

Response: As the commenter noted, risk coefficients used by EPA differ from those of ICRP-26 and from those proposed for EPA occupational guidance. Both EPA and ICRP risk coefficients for occupational guidance are for that purpose - not for the general population.

In the Background Information Document, the Agency noted it was calculating dose-equivalent rates and risks for maximum individuals and populations. Dose rates for individuals were calculated as 70-year committed dose-equivalents.

Concerning the public, the ICRP has recently (ICRP Publication No. 39, Ann. ICRP 14 No. 1, 1984) stated the "more rigorous" 70-year committed dose-equivalent could be applied. They also noted it would be inappropriate ". . . for the Commission to recommend average or typical values of the various parameters as it has been able to do for workers, and each situation must therefore be dealt with on its own."

It is quite expected, therefore, that estimates for the general population will be different from occupational parameters of EPA or ICRP-26.

Comment 4.2.4: The AIRDOS-EPA computer code is inadequate for evaluating the dose from gamma-emitting noble gases at locations close to the release point. (G-2b)

Response: EPA recognizes that calculating external doses due to sources such as a university research reactor poses special problems. The potential receptor can be close to the point of release and dispersion may be dominated by such considerations as downwash or building wake effects. Furthermore, the mean free path of photons in air from emitted noble gases such as argon-41 is of a magnitude comparable to the scale of distances affecting dispersion. The doses calculated by AIRDOS-EPA in such circumstances can either underestimate or overestimate the expected dose to nearby individuals. In such circumstances, a dose assessment which considers such effects more completely than AIRDOS-EPA would be given consideration by EPA.

Comment 4.2.5: There is no indication in the Background Information Document as to whether or not shielding was accounted for in calculating population dose from noble gas emissions. A 0.4 shielding factor for buildings is appropriate. (I-8a, I-8b)

Response: While EPA did not include a building shielding factor in its calculations, such a factor would be appropriate for external photon doses.

Comment 4.2.6: The EPA's analysis of research reactors is based on a source term that overestimates emissions from the reference facility, uses a generic site that overestimates the size of the affected population, and neglects shielding provided by buildings. Correction of the EPA analysis for recent emissions data (0.79), population (0.69), and shielding (0.4), would result in a regional population dose of 75 person-rem/year for the reference reactor, less than 25 percent of the 343 person-rem/year estimated in the BID. (G-2a, G-2b, I-8a, I-8b)

Response: The source term and the generic site used in the assessment were not intended to represent an actual facility. Rather, they were chosen to provide a reasonable upper bound of the doses and risks that could be caused by this class of facilities. EPA agrees that the actual collective dose to the population surrounding the MIT facility is probably closer to the 75 person-rem/year than the 340 person-rem/year estimated for the referenced facility. Using a lower source term and accounting for building shielding would also have resulted in lower estimates of dose and risk to nearby individuals. (See also the response to Comment 4.4.6.)

Comment 4.2.7: The AIRDOS-EPA model does not account for building wake dilution. Further, as the NRC and NCRP have testified, the code has not been validated for the way EPA has used it. (I-30)

The AIRDOS model was designed to model dispersion from a single tall stack. Thus, when applied to multiple short vent sources, it overestimates close-in concentrations by a factor of 5 at 0.5 kilometers. (I-17)

Response: While AIRDOS-EPA does not account for the increase in ground level air concentration due to entrapment of the plume in the building wake, the effect can be approximated by reducing the effective height of the release based on supplementary calculations. The dispersion model is not limited to tall stacks -- it can be used for area sources or short stacks as well. While it is true that the formulation of this buoyant rise calculation presumes a stack release, one seldom encounters releases with a substantial buoyancy flux which are not associated with a stack. Studies have been made to compare the dispersion calculated by AIRDOS-EPA with measured data. Typically, the dispersion estimate of AIRDOS-EPA is within a factor of 2 of the measured value. (Ref: D.E. Fields, C.W. Miller, and S.J. Cotter, "The AIRDOS-EPA Computer Code and its Application to the Intermediate Range Transport of ^{85}Kr from the Savannah River Plant," Proceedings Symposium on Intermediate Range Atmospheric Transport Processes and Technology Assessment, CONF-801064, October 1981.)

Comment 4.2.8: The analysis of the radiopharmaceutical industry in the BID is based on out-of-date information, omits a number of radiopharmaceutical manufacturers (such as Union Carbide Corporation), and greatly underestimates the releases from such facilities. (I-1a, I-1b, I-1c)

Response: The analysis of the radiopharmaceutical industry in the BID is based on the best information available to the Agency at the time the analysis was prepared. Much of the information in the analysis was drawn from a study performed for the Agency by a contractor (TRI79), and Union Carbide Corporation's radiopharmaceutical facility was among the facilities examined by the contractor. While not included specifically in the draft BID, recent emissions data from Union Carbide's facility were also reviewed. EPA is not aware of any additional information that would affect the analysis, and requests to the commenter to provide any such information in its possession, while acknowledged, have not resulted in any specific information.

4.3 Control Technology

Comment 4.3.1: There are no controls available to limit releases from research reactors except lowering of power levels or reducing operating schedules. (G-2a, G-2b)

Response: Releases from research reactors are principally the result of activation of air by neutrons. Such releases can be minimized by the use of carbon dioxide instead of air in beam parts, sealing up compartments to reduce the escape of activation products (most of which are fairly short-lived), and replacement of air by carbon dioxide in compartments to which frequent access is not required.

Comment 4.3.2: Control of tritium from reactors using heavy water is already being carried out with catalytic recombiners. The small amounts released by leakage or evaporation cannot be controlled further. (I-8)

Response: EPA agrees that the amounts of tritium released by leakage or evaporation are small and should require no further control.

4.4 Proposed Limits

Comment 4.4.1: A principal concern with the proposed standards is the incorrect perception on the part of the public and radiation workers that the standards establish thresholds above which public health and safety are jeopardized. (G-16, I-32)

Response: The policy of the Agency is to accept the linear non-threshold hypothesis as a prudent basis for regulation. Under this hypothesis there is no threshold below which exposures can be said to be risk-free. The proposed limit was never intended to be construed as a threshold above which exposure is unsafe.

Comment 4.4.2a: The EPA's failure to consider organ risk differences is inconsistent with accepted radiation protection practice (including the EPA's usual approach). Even the proposed standard for DOE facilities allows for organ doses three times higher than the whole body limit. (G-2a, G-2b)

Comment 4.4.2b: The ICRP recommendation to assign a lower weight to the thyroid dose promotes use of limited resources to provide the greatest reduction in risk. (I-6)

Response (Comments 4.4.2a and b): In the proposed rule, EPA allowed a higher dose for individual organs than for the whole body. This comment is now moot since EPA has withdrawn the proposed rule.

Comment 4.4.3: The standard should be raised and treated as an upper limit so as to provide a margin for accidental releases and to permit the application of the "as low as reasonably achievable" principle or "best available" control technology. To facilitate this, a de minimus level based on the order of the variation in natural background should be set. (G-16, I-1b, I-32, I-40)

Response: EPA has decided to withdraw its proposed standard based on its determination that current practice protects public health with an ample margin of safety. Establishment of a de minimus level is unnecessary.

Comment 4.4.4: It is not clear whether the limit applies to any member of the public or to populations residing near facilities. The distinction is important because controls required to prevent exposure to a population can be different from those required to protect an individual. (G-16)

Response: The proposed limit was intended to be applied to any member of the public (see 48 CFR 15089, April 6, 1983). Thus, the proposed standard was to protect nearby individuals, not the collective population. Although controls used to protect the population at large can differ from those employed to protect the most exposed individual, the EPA believes that decreasing emissions protects both the nearby individuals and the members of the general population.

Comment 4.4.5: To avoid imposing an unnecessary burden on small facilities, the regulation should include a small facility relief clause that would establish a control level below which no dose estimates would be required. The control level should account for location (rural vs. urban), stack height, and mixtures of radionuclides. (P-18b)

Response: The comment does not apply because the standard has been withdrawn.

Comment 4.4.6: The proposed limit of 10 mrem/yr is so restrictive that it could well restrict future power levels, operating times, or worthwhile experimental programs. (I-8a, I-8b)

Response: The comment does not apply because the standard has been withdrawn.

Comment 4.4.7: The construction of new buildings at research reactor facilities with small sites could result in some doses in excess of the proposed limits. (I-8b)

Response: The siting of new buildings should be controlled by use of an effective ALARA program.

Comment 4.4.8a: If the standard is set below the current 500 mrem/yr, it should not be set at what is being achieved now, but should make allowance for contingencies that might require a level several times higher. (I-8b)

Comment 4.4.8b: The proposed 10 mrem/yr limit could have a negative impact upon programs to reduce the volume of low-level waste, particularly the use of incinerators. This is contrary to the intent of the Federal Low-Level Waste Policy Act of 1980. The EPA has not considered possible additional costs to further reduce the emissions from these volume reduction processes in determining whether Executive Order 12291 must be implemented. (G-2b, G-7, G-18, I-32, P-1b)

Comment 4.4.8c: The EPA's proposed 10 mrem/yr whole body dose limit for NRC-licensed and non-DOE Federal facilities, based on available and reasonable control technologies, is laudable. (G-21)

Response (Comments 8a through 8c): The standard has been withdrawn. See response to Comment 4.1.1.

4.5 Implementation

Comment 4.5.1a: If a reasonable limit is set, compliance should be accomplished by environmental monitoring. (I-33b)

Comment 4.5.1b: Compliance for NRC licensees should be managed by the NRC. (P-1b)

Comment 4.5.1c: Unilateral specification of the means of demonstrating compliance is not consistent with the memorandum of understanding between the EPA and the NRC. (G-2b)

Comment 4.5.1d: Demonstration of compliance by means of the AIRDOS and RADRISK computer codes is neither feasible nor valid because: the bulk of the NRC and Agreement State licensees are small institutions and do not have the capability to run these large, complicated computer codes, the codes are not applicable to urban sites with surrounding large buildings, no exclusion areas, varying population, and sources having multiple stacks, and the results are highly sensitive to changes in input parameters, so that each licensee would have to develop his own model (based on long-term study of weather patterns and other local parameters) and obtain approval from the NRC. (G-2a, G-2b, G-16, I-1b, I-1c, I-32, I-33b, I-40)

Comment 4.5.1e: If it is decided to determine compliance through the use of computer codes, then the complete code must be supplied to the users. That is, all radionuclide-specific data should be supplied by the EPA, including dose conversion factors, scavenging coefficients, pathways factors, and so on. (P-18b)

Comment 4.5.1f: Many of the NRC's smaller licensees lack the ability to demonstrate compliance, regardless of whether a computational or measurement approach to compliance is required. (G-2a, G-2b)

Comment 4.5.1g: It is not clear whether compliance is based upon a dose equivalent rate, a committed dose equivalent, or a dose equivalent commitment. A requirement to compute the actual internal dose rate, rather than the committed dose equivalent rate, could be cumbersome, complex, and costly. (G-2b)

Comment 4.5.1h: The EPA must specify compliance monitoring as required by the Act. (P-15a)

Comment 4.5.1i: The proposed standard requires implementation using calculations based on the EPA's AIRDOS-EPA and RADRISK codes or modeling techniques which, in the EPA's judgment, are as suitable for a particular application as the EPA codes. However, in the FR notice, the discussion states that implementation will follow established NRC practice, which is based on review of control measures used by licensees. Thus, there is uncertainty as to whether our control measures, as reviewed and approved by the NRC, will be judged by the EPA to constitute acceptable modeling techniques. (I-8a, I-8b)

Response (Comments 4.5.1a through 4.5.1i): See response to Comment 4.1.1.

Comment 4.5.2a: It is not clear that all research reactors can comply with the proposed standard, and the Irwin, Tennessee, plutonium fuel facility may not be able to comply. (G-2a, G-2b)

Comment 4.5.2b: If medical facilities are not able to comply or cannot determine that they are in compliance, health care will be impacted. (I-17, P-9)

Response (Comments 4.5.2a and b): The analysis of research and test reactors included a review of airborne emissions from every such facility required to submit effluent data to the NRC. Based on this review and the results of our analysis of the reference facility, we believe all existing research reactor facilities do comply with the proposed limit. The proposed limit provided an adequate margin for changes in power levels, operating schedules, and programmatic changes. Compliance or noncompliance of the Irwin, Tennessee, plutonium fuel fabrication facility is moot, as the plant has not processed any plutonium in more than a decade, and is being decommissioned.

The record strongly supports the fact that all medical facilities were in compliance with the proposed rules.

Comment 4.5.3: The Land Management Bureaus within this department do not have the responsibility to establish, as suggested by the EPA, radionuclide standards for public lands. Indeed, we cannot acquire the skilled personnel required to develop such standards, nor even assure compliance with the EPA's proposed standard given our existing skill mix. (G-19)

Response: See response to Comment 4.1.1.

Comment 4.5.4: The doses calculated by the EPA for the reference research reactor differ from the doses we calculate by a factor of 7.5. This illustrates the uncertainties that may exist in demonstrating compliance. (I-8b)

Response: The person submitting this comment is apparently under the belief that the reference reactor is identical to an existing facility (one owned by the commenter). This belief is incorrect. The reference reactor is a hypothetical facility assigned a set of parameters (emissions, meteorology, etc.) for purposes of analysis. The difference of a factor of 7.5 comes about by comparing the reference reactor to a real facility.

4.6 Costs

Comment 4.6.1: The EPA has failed in most instances to consider costs either for controls or for compliance. In the few instances where costs for controls were addressed, the analysis clearly demonstrates that the benefits do not justify the costs. (G-2a, G-2b)

Response: The Agency believes that giving equal weight to costs and benefits is inappropriate in developing standards under Section 112 of the Clean Air Act. Congress intended that public health protection considerations be primary and that cost be a secondary consideration. The Agency considered costs to a limited degree consistent with this overall perspective in reaching its decisions on coal-fired boilers and elemental phosphorus plants, but the decision to withdraw the standard for NRC licensees and non-DOE Federal facilities does not rest on cost considerations.

Comment 4.6.2: The EPA indicates that the paperwork burden of keeping additional records would be very large and unjustified. On the other hand, if licensees are not required to document compliance with the limitations, then issuing the regulations is futile. (G-2b)

Response: EPA believes the record indicates that all facilities subject to the proposed rules were in compliance. The proposed rules relieved most small facilities of the paperwork burden of demonstrating compliance. Since EPA has withdrawn the proposed standard, there will be no paperwork burden.

Comment 4.6.3a: Adoption of this rule could seriously affect Department of Defense programs in the areas of research reactor operations, use of depleted uranium shells, nuclear medicine, and nuclear weapons testing. Under Section 112, it may not be possible to obtain Presidential exemption, and therefore the government may be forced to pay exorbitant costs to pursue essential objectives if the standards are to be met, even though there is little or no benefit in compliance. (G-16)

Comment 4.6.3b: The high costs of implementing the proposed rule and demonstrating compliance at such infinitesimally low annual exposure levels will seriously affect radiopharmaceutical manufacturers, bio-medical facilities, and medical institutions. The costs could result in reduced availability of radiopharmaceuticals, reduced funds available for bio-medical research, and higher medical costs. This could negatively impact public health care. (I-16, I-17, I-32, I-33a, I-33b, I-37a, I-41, P-9).

Response (Comments 4.6.3a and b): EPA disagrees that the costs of implementing the proposed rule are high or that DOD programs would have been seriously affected. However, these comments have been rendered moot by EPA's decision to withdraw the proposed rules.

Comment 4.6.4a: The EPA has greatly underestimated the costs of complying with the proposed rule. First, the estimate in the BID of the number of affected licensees is far too low. NRC testimony cites 7,500 NRC licensees and 12,500 or more Agreement State licensees. Second, the EPA's estimates of the costs are too low. The EPA has assumed that the NRC's enforcement of the proposed rule would not require annual proof of compliance by each licensee. Because of variations from one facility to another, generic methods could not be used. Proof of compliance would cause the expenditure of hundreds of thousands of dollars for each radiopharmaceutical manufacturer and tens of thousands of dollars per hospital. The costs will exceed $100,000,000 per year and therefore a regulatory impact analysis is required under Executive Order 12291. (G-2a, G-2b, I-16, I-17, I-32, P-9).

Response: See response to Comment 4.1.1.

Comment 4.6.4b: The costs of complying with the proposed standard have not been determined, but one licensee estimates capital costs alone would approach one million dollars at its facility. (I-19)

Response: EPA disagrees that any capital costs would have been required to comply with the proposed standard. EPA believes that all facilities covered by the proposed rule were in compliance with it.

Comment 4.6.4c: Compelling each licensee to monitor or model emissions to demonstrate compliance with this inordinately low level of exposure will increase costs for the facilities and the NRC as the regulating agency without any tangible health benefit. (I-19)

Response: Compliance is not necessary since no numerical standard is now proposed.

4.7 Other Comments

Comment 4.7.1: The EPA's statement that research and test reactors are not required to submit data on air emissions to the NRC is incorrect. (I-8a)

Response: In the past, not all research and test reactors were required to submit data on air emissions to the NRC. A requirement to include information on air emissions in the annual report to the NRC is being added to the technical specifications as each license is renewed.

Comment 4.7.2: The EPA should clarify the applicability of its proposed standard to licensees using only sealed sources and/or conducting enclosed activities that result in low level fugitive emissions into enclosed areas. (I-49)

Response: Licensees using only sealed sources were excluded from the proposed standards.

5.0 UNDERGROUND URANIUM MINES

5.1 Basis for the Standard

Comment 5.1.1a: Because radon emissions from uranium mines pose insignificant health risks, regulation under Section 112 of the Clean Air Act is inappropriate. (I-3b, 47)

Comment 5.1.1b: Has it been shown that there is a significant increase in radon near mine vents? The Salt Lake City tailings pile releases over 5000 curies per year; yet it cannot be detected over natural radon one-half mile away. (P-1b)

Response (Comments 5.1.1a and b): EPA has assessed the risks from radon emissions from underground uranium mines and has concluded that the risk of fatal cancer to individuals living near large underground uranium mines and to the total population both regional and national is significant. Data collected in the State of New Mexico shows that radon-222 concentrations in air near underground uranium mines are significantly elevated above naturally occurring levels.

Comment 5.1.2a: The proposed standard is wholly unacceptable. The residual risks are far too high. (P-15a)

Comment 5.1.2b: The high background radon concentrations in the vicinity of mines increase the need to regulate the emissions of radon from mines. (P-3b)

Comment 5.1.2c: People living in areas close to uranium mines should be protected and should receive the same level of protection as people living in more populated areas receive from emission of radioactive material. (I-52)

Response (Comments 5.1.2a through c): EPA agrees that individuals living near underground uranium mines should be protected from risks caused by radon-222 emissions from these mines.

The Agency orginally proposed a standard to limit radon concentrations in air due to emissions from underground mines. Based on public comment, it is the EPA's judgment that it is not feasible to prescribe or enforce an emission standard for radon-222 emissions from underground mines because radon-222 cannot be emitted through a conveyance designed to capture the gas under current conditions. The Agency considers the risks from underground uranium mines to be significant and believes action is needed to protect populations and individuals living near underground uranium mines. Therefore, EPA has decided to begin development of work practice, design, equipment, or operational standards to control radon release from underground mines.

Comment 5.1.3: The EPA should include abandoned mines in the proposed standards. Battelle Pacific Northwest Laboratories has informed EPA that radon emissions from abandoned mines constitute a hazard. (P-3a, P-3b)

Response: EPA has assessed the radon emissions from inactive underground uranium mines (EPA 520/1-83-007). These emissions were found to be quite small. The radon-222 emissions from an inactive underground mine were estimated to be about 1/500 of the radon-222 emission from an average large operational underground mine. Based on this assessment, EPA has concluded that a standard for inactive underground uranium mines is not needed.

Comment 5.1.4: The EPA should set an emission limit, the standard preferred by Congress, rather than restricting the annual average concentration of radon in the vicinity of mines to 0.2 picocuries per year above background. (P-3b, P-15a)

Response: See response to Comment 5.1.2.

Comment 5.1.5: The draft study of radon done by the New Mexico Environmental Improvement Division should be considered by the EPA in developing the radon standard for uranium mines. (I-52)

Response: This study has been considered by EPA in evaluating underground uranium mines.

Comment 5.1.6: Using the philosophy of comparable risks, ICRP-26 recommends a risk to critical groups of 1×10^{-4}/year. For radon, this is equivalent to approximately 0.75 WLM/year, which corresponds to a radon concentration of 3 pCi/l. The 0.2 pCi/l standard originally proposed by the EPA results in a lifetime lung cancer risk of 0.03 percent, or 5×10^{-6}/year. The lifetime risk of 0.03 percent, when added to the average total risk of all cancer deaths of 16.7 percent, results in an increased risk that is probably epidemiologically undetectable. (I-17)

Response: The commenter has apparently misread ICRP-26. ICRP-26, paragraph 122, states, relative to a critical group, "In these cases, the dose-equivalent limit to individual members of the public, referred to in paragraph 120, would still adequately restrict the average dose equivalent, but the few individuals exposed to the dose-equivalent limit could run a risk in the range of 10^{-5} to 10^{-4} per year. This annual risk would then be one order of magnitude higher than the risk range quoted in paragraph 118. Since exposures at the dose-equivalent limit are not likely to be repeated over many years, however, an adequate restriction of the lifetime dose is still likely to be achieved. In rare cases where the doses to a few individuals were actually found to be received at high rates over prolonged periods, it would be prudent to take measures to restrict their lifetime dose as implied in paragraph 119."

Paragraph 119 restricts the lifetime dose to a value corresponding to 1 mSv per year of life-long whole body exposure, an average risk of approximately 1 x 10^{-5} per year.

Based only on epidemiology, and not including estimated dosimetry and weighting factors, the ICRP estimated a total lifetime risk of 1.5 to 4.5 x 10^{-4}/WLM. This estimate was based on selected data and a 30-year mean manifestation period. (ICRP-32 Ann. ICRP 9, No. 1, par 8, 1981.) While this might be reasonable for an occupational exposure in miners, it is not valid for a population exposure and hence would not be used in any case.

The commenter appears to have lost a factor of 10 in translating the Agency's risk estimate for 0.01 WL to that for 0.2 pCi/l. The Agency estimated a lifetime risk of .017 for fatal lung cancers for continuous exposure at 0.01 WL or about 2.4 deaths per year per 100 person WL (BID p B-12). This would be 2.4 x 10^{-2} deaths/year per person WL or 2.4 x 10^{-5} deaths per year per person at 0.001 WL. Continuous exposure at 0.2 pCi radon per liter would give an average individual risk of 2.4 x 10^{-5} if equilibrium is 0.5; or 3.3 x 10^{-5} if equilibrium is 0.7, not the 5 x 10^{-6} risk/year calculated by the commenter. Likewise, the lifetime risk would be 0.17 percent or 0.24 percent depending on equilibrium factor used, not 0.03 percent.

While it is probably true that the increased risk is probably epidemiologically undetectable, that does not make it less real.

Comment 5.1.7: The reliance on land control rather than setting an emission standard is contrary to the Act. (P-15a)

Response: See response to Comments 5.2.1a through c.

Comment 5.1.8a: The EPA should follow the system employed in 40 CFR 190, setting the standard for the nearest inhabitant. (I-26)

Comment 5.1.8b: The standard should be established to protect real people from unreasonable risk. (I-3b)

Response (Comments 5.1.8a and b): See response to Comment 5.1.2.

Comment 5.1.9: We strongly support the need for standards, but the proposed standard fails to consider regional impacts from multiple sources. Such an approach would allow radon to accumulate and exceed the proposed standard based on a single source. (G-20, P-15a)

Response: EPA will consider regional impacts from multiple sources in developing any design, equipment, work practices, or operational standard for underground uranium mines (see Section 5.6 of BID).

Comment 5.1.10: The EPA should consider setting a standard that includes background, as this would make monitoring easier and less costly. (G-20)

Response: See response to Comment 5.1.2.

Comment 5.1.11: In a 1972 report, the EPA stated that uranium mining and milling were insignificant sources of radioactivity when compared with natural background levels. Nothing has been developed since that time to change that conclusion. In fact, this was reinforced in the NRC's most recent report on the subject (NUREG-0757). (I-3b)

Response: While emissions from uranium mining and milling are only a tiny fraction of natural background radiation, they can have a significant impact on nearby individuals and the total population. The elevated concentrations in the vicinity of a mine vent can result in relatively high risks to exposed individuals.

Comment 5.1.12: Natural radionuclides are not the type of pollutants that were intended to be regulated under Section 112 of the Clean Air Act. (I-3a)

Response: Section 112 of the Act does not distinguish between man-made and naturally occurring pollutants. In absence of such a distinction, we can only conclude that Congress intended EPA to regulate all sources of radionuclides presenting a significant risk to the public health.

5.2 Dose and Risk Calculations

Comment 5.2.1a: The assumptions and parameters used in the EPA's radon-222 risk analysis do not conform to either accepted values recognized by the radiation health community or available evidence. In its analysis, the EPA:

a. Overestimates the rate of radon release.

b. Neglects the effect of plume rise.

c. Assumes a one micron particle size instead of using the known distribution.

d. Uses an inappropriate model for estimation of dispersion and transport.

e. Overestimates the equilibrium factor between radon and its daughters.

f. Neglects the latency period for the development of lung cancer.

g. Assumes an exposure period of 70 years to a mine whose average life is only 15 years.

h. Uses estimates that are higher than ICRP and NCRP recommended values.

i. Fails to justify the use of relative instead of absolute risk.

(I-1b, I-3b, I-3c, I-22, I-23, I-26, I-31, I-37b, I-47, P-1b)

Response to a: The Agency did not estimate the rate of radon release from underground mines. Rather, the Agency used radon emission data from actual measurements performed by the Battelle Pacific Northwest Laboratory (PLN) (Ja80). These data were then used to select the parameters for the reference underground uranium mine which, in turn, was subjected to further analysis.

Response to b: The comment is correct. The Agency did not consider the effect of plume rise when calculating radon exposures and risks. Plume rise is considered in the final BID where estimates of radon exposures and risks for both ground level releases and releases with plume rise are presented. The plume rise estimates apply to vertical discharge vents and the ground level estimates to horizontal discharge vents. Currently the Agency has no reliable information regarding the relative fractions of horizontal and vertical discharge vents.

Response to c: The calculations for radon-222 concentration do not use particle size as a parameter.

Response to d: The dispersion method used by the Agency has been the basic workhorse of local dispersion estimation for years. In 1977, the participants of an expert group assessing atmospheric transport of radionuclides concluded that, for distances out to 10 km in reasonably flat terrain, and given good local wind observations: "Accuracy for the usual annual average concentration is about a factor of ± 2." (Ho78) Furthermore, these dispersion estimates are based on an empirical approach that is inherently unbiased and that should therefore be as likely to overpredict as to underpredict.

The model used to predict concentrations near mine vents is also a proven model used by EPA for many years. The Industrial Source Complex model has been used by the EPA air pollution program for industrial stacks.

Response to e: The commenter is questioning the use of an equilibrium fraction of 70 percent for radon daughters in structures. Observations of this fraction are highly variable. The degree of equilibrium depends on many variables such as ventilation and plate out but is also strongly dependent on the degree of equilibrium which exists in the incoming air. For example, a calculation using a ventilation rate of 1 h^{-1} and an effective plate out rate of 1 h^{-1} yields an equilibrium fraction of 0.36 for an initial equilibrium fraction of 0 and 0.68 for an initial equilibrium fraction of 1.0. Since the degree of equilibrium in the air entering structures within areas adjacent to a source would be expected to be low under normal meteorological conditions, EPA has reduced its estimate of the equilibrium fraction by one half for the calculation of risk to maximum exposed individuals. Although some have suggested lower values, these appear to be based primarily on studies of structures in which the radon entered only by diffusion so that the initial equilibrium fraction was zero.

At some distance from a source, the equilibrium of radon in air may approach 1.0, so for structures at some distance from a source, an equilibrium value of 0.7 will still be correct for population risk estimates.

Response to f: EPA uses a life table approach to calculate stochastic risk. The latency period, i.e., the minimum induction period, and the risk plateaus, are an integral part of these calculations. Latency is accounted for on an annual basis for each successive year of life. The methodology is described in Appendix B of the Background Information Document.

Response to g: The comment refers more to individual risk estimates than those for the region or nation. A worked out mine is quite likely to be replaced by another mine in that region so that regional and national exposures will continue. If the distribution of individuals near the new mine is similar to that around the worked out mine, the individual risks will, on the average, be the same as if the original mine continued across the life span of both mines. So it is not certain that even the individual risk estimates are excessive.

Response to h: The Agency reviewed ICRP and NCRP estimates in the "Final Environmental Impact Statement for Standards for the Control of Byproduct Materials from Uranium Ore Processing (40 CFR 192) Volume II" (EPA 520/1-83-008-2). The response to this comment is adapted from that document.

The current Agency estimate for radon-222 exposure is 760 fatal cancers per 10^6 person WLM for lifetime exposure and lifetime expression of risk.

A comparison of the Agency estimate and assumptions compared with those from ICRP and NCRP is given below:

I. EPA 760/10^6/WLM
assumptions:
a. lifetime exposure from birth (0-110 yrs. with actuarial probability of death due to all causes in this interval)

b. a relative risk of 3%/WLM

II. ICRP - 150-450/10^6/WLM (ICRP-Report 32)
assumptions:
a. risk of 5-15/10^6/yr/WLM
b. mean manifestation period of 30 years
c. exposure from age 18 to 65

This epidemiology based estimate of the ICRP is not directly comparable to EPA's. The periods of opportunity for expression in the EPA model are greater since exposure is considered to start at birth and the mean life expectancy is 70 years. While the numbers cannot be compared because of differences in age structures and competing risks in the two populations, a first approximation could be made by doubling the ICRP estimate to account for the more extended period for expression. In this case, the ICRP estimate would be equivalent to 300-900/10^6/WLM.

It should also be noted that the ICRP assumption of an annual risk 5-15/10^6/yr/WLM is an estimate based on values ranging from 2 to 20/10^6/yr/WLM, which were averaged over all age periods during occupational exposure. Their 2-20/10^6/yr/WLM is the range of estimates they took from epidemiologic studies. The true range is greater since Archer(16) documented a range of 1.4 to 35.0/10^6/yr/WLM and BEIR-3 documents a range of 6-47/10^6/yr/WLM. The ICRP estimate is perhaps a factor of 2 too low for occupational exposure and a factor of 4 too low for valid comparison with the EPA estimate.

III. NCRP - 80-200/10^6/WLM (unpublished, referred to by the commenter)
assumptions:
a. 10/10^6/yr/WLM
b. no lung cancers before age 40
c. induced cancers disappear exponentially with a halftime of 20 years
d. lifetime exposure from birth (0-85 + years)

While EPA cannot use data from an unpublished draft report in support of rulemaking, this estimate can be compared to EPA's in the discussion of comments. The NCRP model has a unique feature not found in other lung cancer risk models, i.e., radiation induced lung cancers disappear or become unavailable for expression with time. Mathematically a function is introduced which removes cancers exponentially with a halflife of 20 years. It is not clear why this function is introduced or where it is supported by valid observations and analysis. If this function is removed, the NCRP estimate increases from about 80-200/10^6/WLM to 200-500/10^6 WLM.

Moreover, the NCRP estimates an average of 10/10^6/yr/WLM lung cancers could occur. As noted above, Archer(16) documented a range of 1.4 to 35/10^6/yr/WLM and BEIR-3, 6 to 47/10^6yr/WLM. It is not certain to what extent NCRP considered the entire range of risk estimates but their risk coefficient 10/yr/WLM is about half of the BEIR-80 risk coefficient (averaged for all ages). In addition, absolute risk coefficients should be weighted by the length of the follow-up in the study, since for less than lifetime follow-up the absolute risk coefficients increase with increasing length of observation, (BEIR(3), (17). For example, a weighted average for exposures to less than 500 WLM in Archer's paper yields about 17 cases /10^6/yr/WLM. It is likely that the NCRP estimate is another factor of 2 lower than it should be.

IV. ICRP - 45-138/10^6/WLM (ICRP-32)

The ICRP dosimetric approach is subtle. As ICRP Report 32 points out, their risk concept assumes a proportional relationship without threshold between the dose to relevant target tissues and the associated excess probability for the induction of cancer. ICRP 32 then continues, "On the basis of this concept the risk-relevant dosimetric quantities for radon daughters in the lung are the mean dose or dose equivalent to the two target tissues mentioned above, the basal cell layer in the tracheobronchial (TB) region and the mean dose to the epithelium in the pulmonary (P) region." ICRP 32 then uses dosimetric models to calculate the dose equivalents of interest; these models contain assumptions that introduce considerable uncertainties. These uncertainties coupled with ICRP assumptions on weighting factors and quality factors lead to very uncertain conclusions.

However, even if these models are correct, ICRP's use of the mean dose-equivalent for bronchial tissue reduces the REM/WLM by about a factor of 3 since the dose equivalent in the region of the lung where most cancers develop (lobar, segmental, and subsegmental bronchi) is about 3 times higher than the mean dose calculated in the models referenced by ICRP 32. Likewise, ICRP split the risk weighting factor for lung cancer between bronchi and pulmonary lung, so that each has 50 percent of the risk originally calculated by ICRP for the lung. This reduces the REM/WLM by a factor of 2. Since no radon daughter-related cancers have ever been observed in the pulmonary lung, this approach introduces a likely error in the estimate for bronchi cancer by a factor of 2. Correcting for these ICRP assumptions would increase their risk estimate to about 270-828/10^6/WLM. Adjustments for lack of follow-up in the studies from which ICRP derived its estimate of 1.2×10^{-2} cancers/Sv (ICRP 26) would increase the risk estimates still further.

Response to 1: The absolute risk and relative risk models were introduced in BEIR-1 and used in BEIR-3.

As currently defined: (BEIR-3)

Absolute Risk - "Expression of excess risk due to exposure as the arithmetic difference between the risk among those exposed and that obtaining in the absence of exposure."

Relative Risk - "Expression of risk due to exposure as the ratio of the risk among the exposed to that obtaining in the absence of exposures."

The risk projection models are also defined in BEIR-3: Absolute Risk Projection Model which states, "According to this model, if a population was irradiated at a particular dose either all at once or over some period, expressions of excess cancer risk in that population would begin at some time after exposure (the latent period) and continue at a rate in excess of the expected rate for an additional period, the 'plateau' or expression period, which may exceed the period of followup. In this model, the absolute risk is defined as the number of excess cancer cases per unit of population per unit of time and per unit of radiation dose, and, though it may depend on age at exposure, it does not otherwise depend on age at observation for risk."

Relative Risk Projection Model - "In the second model adopted in BEIR-1, the so called relative-risk model, the excess cancer for the interval after the latent period was expressed as a multiple of the natural age-specific cancer risk for that population. The chief difference between the two models is that the relative-risk model took account of the differing susceptibility to cancer related to age at observation for risk."

"If the relative-risk model applies, then the age of the exposed groups, both at the time of exposure and as they move through life, becomes very important. There is now considerable evidence in nearly all the adult human populations studied that persons irradiated at higher ages have in general a greater excess risk of cancer than those irradiated at lower ages, or at least they develop cancer sooner. Furthermore, if they are irradiated at a particular age, the excess risk tends to rise pari passu with the risk of the population at large. In other words, the relative-risk model with respect to cancer susceptibility as a function of age evidently applies to some kinds of cancer that have been observed to result from radiation exposure."

The 1980 BEIR Committee also makes some caveats regarding the certainty of our knowledge of the two models. However, they later commented (p. 137), "If risks are given in absolute form - i.e., number of cancers induced per unit of population and per unit of radiation expcsure - then a single value independent of age may be inappropriate." For lung cancer the 1980 BEIR Committee used no single value but a risk coefficient which varied with age.

Since BEIR-3 provides an extensive analysis of lung cancer induction due to radon progeny, the projection model they used - age specific absolute risk - was compared to the relative risk model used by EPA. Since there was very little numerical difference, EPA has concluded that its relative-risk model and the BEIR 1980 age-dependent absolute risk model are essentially equivalent.

A study by Land and Norman supported a relative risk model for lung cancer. In the discussion of a Smith and Doll paper, on page 216, Smith said, "The statement I made was based on our finding that the risk of a radiation-induced cancer seems to increase with age at exposure in direct proportion to the expected number of deaths from cancer that would be suffered by persons first treated at a particular age. This suggests to us the radiation is interacting with whatever other factors are inducing cancer." This statement is comparable to the definition of relative-risk given by BEIR-3. Since BEIR-3 (p. 312-313) reported a significant increase in lung cancer in the population studied by Smith and Doll, it is reasonable to consider lung cancer one of the cancers described by Smith's statement.

A Kato and Schull report (H. Kato and W. J. Schull, Radiation Res., 90: 395-432, 1982) concluded, "Thus, though in the recent BEIR report two different models (relative risk and absolute risk models) have been used for projection of risk beyond the period of observation, the present data support the relative risk model projection more strongly. The excess deaths from cancers other than leukemia increase with age at death for the same age cohort in proportion to the age-specific death rate from cancers in the population of all Japan and do not show a constant excess value by age at death for the same age cohort."

A report by Shi-quan and Xiao-ou shows that even at ages less than 10, exposure to radon does not lead to lung cancer before the age at which "spontaneous" lung cancer develops. This pattern is consistent only with relative risk and age specific absolute risk lung cancer induction models. It is not consistent with simple absolute risk; thus, it lends additional support to EPA's use of the relative risk model.

In an extensive review of the health effects of alpha radiation for the Canadian Atomic Energy Control Board, the authors selected a relative risk projection model and concluded the best estimate of excess relative risk for the radon exposure data was 2.28 percent, ± 0.35 percent, and that this was unlikely to underestimate the excess risk at low doses by more than a factor of 1.5. They further concluded the risks from radon daughters and smoking were intermediate between multiplicative and additive but on the balance chose multiplicative.

Most recently Prentice, et al. (R.L. Prentice, et al., JNCI, 70:611-622, 1983) and Whittemore and McMillan, (A.S. Whittemore and A. McMillan, Technical Report No. 68, prepared for SIMS, Stanford

University, California, 1983) have used the relative risk projection model on estimating radon related lung cancer hazards.

In conclusion, EPA believes the record clearly justifies the use of relative risk for radon-222 exposures.

Comment 5.2.1b: The EPA assumption of a risk of 1 or 2 in 100 for exposure to 0.007 to 0.014 working level months seems high. R.D. Evans, et al.'s risk estimates would lead to 2 to 5 x 10^{-3}; the NCRP Subcommittee 57 report gives about 6 x 10^{-3}. The risk estimates used by the EPA are consistently high. For example, the radon risks are cited as 1-2 per 100 lifetime exposure to an equivalent concentration of 1-2 pCi/l radon. The same risks are given by R. D. Evans, et al. and by a recent NCRP committee as 0.2 - 0.5 in 100. (P-1a, P-1b)

Response: The Agency does not feel its risk estimates for radon exposure are too high compared to other estimates.

RISK ESTIMATE FOR EXPOSURES TO RADON PROGENY

Organization	Fatalities per 10^6 person WLM	Exposure Period	Expression Period
EPA (a)	760	Lifetime	Lifetime
NAS BEIR-3 (a)	730	Lifetime	Lifetime
AECB (b)	600	Lifetime	Lifetime
UNSCEAR	200-450	Lifetime	40 years
ICRP	150-450	Working Lifetime	30 years
NCRP (c)	130	Lifetime	Lifetime
Evans, et al.	100	?	?

(a) Assumes increased exposure during childhood, due to high minute volume for lung size compared to adult.

(b) Adjusted for U.S. General Population.

(c) Assumes risk diminishes exponentially with a 20-year halftime.

Specific aspects of the ICRP and NCRP (Harley and Pasternak) models are mentioned in the response to Comment 5.2.1h.

It is uncertain how the Evans et al. estimate was made. The paper goes from selected annual risk coefficients in some miners to a lifetime estimate without indicating latent periods, period of expression, etc. Apparently they assumed a 15 year expression period even though the documented risk is over twice this long. These problems, in addition to other questionable assumptions, cast doubt on the validity of this estimate in comparison to more fully documented estimates for which there is an adequate rationale.

Comment 5.2.1c: A uranium mine only has a working lifetime of 10 to 15 years. (I-1a, I-3a)

Response: EPA's model mine was assigned a 20-year operational lifetime. The choice of this parameter was based on information presented in the Final Background Information Document (Table 5-8) which shows that during 1978-1979 the age of underground uranium mines ranged up to about 30 years, with the age of older mines averaging 21 years. See response to Comment 5.2.1g.

Comment 5.2.1d: The EPA is bound by the requirements of the Clean Air Act to evaluate the potential risks and establish standards based on reasonable assumptions. Moreover, the assumptions must be explained, justified, and presented with margins of error. By failing to do this, the EPA has misled the Administrator and the public as to the risk from underground uranium mines. (I-3b)

Response: EPA believes its risk estimates are based on reasonable assumptions and valid methods. The assumptions and methods used by the Agency to estimate risks from radionuclide emissions to air, and the uncertainties in these estimates are described in the Final Background Information Document.

Comment 5.2.2: The EPA should better explain its rationale for the differences between its estimates of risk for uranium mines and those for uranium milling. (I-1b)

Response: Radon produces the greatest risk from both of these facilities. There is little difference in the methodology used to estimate risk from radon from uranium mines and from uranium mill tailings. The most significant difference is that the sources of radon have different configurations - area source for tailings and point source for uranium mines. However, this difference is rather small since most mines have several vents (several point sources) which in practice can be considered an area source. Therefore, in modeling environmental pathways for radon risk estimation, differences are minimal between mines and mill tailings.

Probably the greatest difference between the two is that tailings can be (and have been) used as a construction and/or fill material around structures. This leads to very high risk estimates from the buildup of indoor radon decay products. Two important considerations apply here. First, this pathway of misusing tailings does not exist for uranium mine radon releases. Second, EPA does not believe there is a reasonable way to model or estimate the impact of this pathway since it is highly dependent on local mines, etc. Therefore, this misuse problem must be considered qualitatively, thereby greatly limiting comparative analyses.

Comment 5.2.3: Epidemiological studies in Colorado and Pennsylvania have failed to show any increased risk from radon. (I-31)

Response: As noted by the Colorado Department of Health (Comment 2.2.5c), "It was stated earlier in this [Denver] hearing that the epidemiological studies done in Grand Junction by the Colorado Department of Health have not indicated that there is a bioeffect from exposure to the radiation levels observed. This is not a conclusion of the study. [emphasis added]."

The Pennsylvania study (of Dr. Steven Lane) did not have adequate power to detect the presence of a radiation effect if it was present. See response to Comment 2.2.5a.

In neither case was a sufficiently large population followed for a long enough time. Neither study is capable of demonstrating the increased risk of radiation bioeffects if they are present.

Comment 5.2.4: The source term for radioactive airborne emissions used by the EPA is overestimated by the assumption that all particles have a diameter of 1 micron. Thus, the EPA overestimates the source term that can be transported to individuals living near a uranium mine. (I-17)

Response: EPA did not assume a one micrometer particle diameter in estimating the source term for uranium mines. The only radionuclide considered for a mine was radon. It is an inert gas (deposition velocity of zero). Its daughters were taken to be at 70 percent of their equilibrium value. This 70 percent factor has been changed to a distance dependent percent and is shown in the Final Background Information Document.

Comment 5.2.5: Extrapolation of lung cancer risks from occupational exposures of miners understates risks to children who may spend almost 100 percent of their time indoors, and ignores the synergistic effects of simultaneous exposure to radiation and other toxins. (P-15a)

Response: The Agency disagrees since the lifetime risk of continuous exposure has been calculated. Infants, who spend most of their time indoors, contribute little to the lifetime risk of continuous exposure. Even if children remained indoors 100 percent of the time until school age (age six), their increased contribution to exposure would be about 3 percent of the total exposure, much less than the uncertainty in the calculation. Age-specific differences in physiology are incorporated in the Agency model and, since a relative risk projection model is used, all synergisms are automatically included.

Comment 5.2.6: The EPA has presented the risk estimates in a manner that is misleading. As an example, in the case of underground uranium mines, the EPA states that a hypothetical maximum individual who lives 500 meters from an exhaust vent and is constantly exposed will have an increased risk of lung cancer of 1 or 2 in 100. This distorts the potential risk to the public. EPA also acknowledges that a large underground uranium mine would require 30 years of operation to produce 1 health effect. This is twice as long as the ordinary life of such a mine. (I-3b)

Response: The Agency did not intentionally overestimate the risk from radon to nearby individuals. There are 42 people who live within 500 meters of uranium mines (see Table 5-12 of the final BID). There are 8 mines that have an average life of 21 years and range fron 17 to 29 years old (see Table 5-7 of the final BID). [The risk estimates have been modified by presenting a range of radon risks to reflect the difference of opinion among the scientific community regarding the risk from exposure to radon decay products.]

Comment 5.2.7: EPA's risk coefficient for exposure to radon decay products is not supported by observations among underground uranium miners. (I-3a)

Response: The Agency disagrees. The Agency risk coefficient for radon is derived from the uranium miner data base. It is numerically almost identical to that in BEIR-3 (reference NAS806) and within the environmental level risk coefficients derived by Archer for the same data base (reference Ar79). It is also quite similar to environmental level risk coefficients in an AECB of Canada review of alpha radiation (D.C. Thomas and K.G. McNeill, "Risk Estimates for the Health Effects of Alpha Radiation," INFO-0081, Atomic Energy Control Board, Ottawa, Canada, 1982).

Agency risk coefficients are not the lowest reported, but they are not the highest either. They are, hopefully, realistic, but prudent.

Comment 5.2.8: Measurements at Ambrosia Lake suggest that natural background sources of radon overwhelm contributions of radon from uranium mines. (I-3a)

Response: While it is true that background sources will exceed radon emitted from underground uranium mines with respect to population exposures, this is not the case with respect to doses received by individuals living near mine vents. For individuals close to uranium mines, the radon releases from the mine vents can cause a significant exposure and risk.

Comment 5.2.9: EPA assumes an equilibrium of 70 percent for indoor radon decay product concentrations. Measurements at Ambrosia Lake indicate that the equilibrium factor is far less than 70 percent. (I-3a)

Response: See response to Comments 5.2.1a, Part e, and Table 5-10 in the final Background Information Document (BID).

5.3 Control Technology

Comment 5.3.1: The A.D. Little study done for the EPA identified a number of options for the removal of radon from mine exhaust, the most promising of which appears to be activated carbon filtration. Given this technology, the high level of risk from mine radon in the proposed standards is unjustified. (P-15a, P-15b)

Response: Studies performed for the Agency have identified a number of control technologies to control radon releases for underground uranium mines. The effectiveness and costs of these technologies are discussed in the BID. Activated carbon filtration of radon in mine ventilation air has not been demonstrated in actual mines and is not believed to be practical. In EPA's consideration of a work practice standard, the Agency will consider the use of activated charcoal filters in conjunction with bulkheading.

Comment 5.3.2: The three control options for mines are impractical.

a. Private companies have no power of eminent domain; therefore, purchase of surrounding land at a reasonable price will be impossible.

b. The methods suggested by the EPA to control radon emissions are not practical; if they were, they would already be in use.

c. The use of tall stacks is not practical for a number of reasons. Even if they were, the proposed standard gives no credit for them. (I-26, I-37b, I-43b)

Response: See response to Comment 5.1.2.

Comment 5.3.3: The EPA wrongly assumes that radon reductions from sealant coatings, bulkheading, activated carbon, and backfilling are additive. (I-3b)

Response: Our analysis of radon control technologies in the BID does not assume that radon reductions for various control technologies are additive. Only the reductions from bulkheading and adsorption on activated carbon of the radon bled from the bulkheaded areas are additive and treated as such in the BID. The revised table in the final BID reflects this more clearly. EPA believes this approach is reasonable.

Comment 5.3.4: Curtailing operations to reduce emissions is useless, as the ventilation system must operate continuously. (I-22)

Response: Curtailing operations to reduce emissions is only effective if the shutdown is for prolonged periods of time. Short-term shutdowns would not be effective in reducing radon emissions.

Comment 5.3.5: Emission limits under Section 112 of the Act are intended to be technology forcing. The EPA has ignored this and underestimated the effectiveness of existing technology (e.g., sealants) and the ingenuity and creativity of American industry. (G-22, P-15a)

Response: See response to Comment 5.1.2.

Comment 5.3.6: The EPA has ignored several potential control technologies for radon, including capture on activated charcoal, cryogenic distillation, and scrubbers using dioxygenyl hexafluorantimonate as an oxidant. Our discussions with knowledgeable scientists lead us to conclude that these are viable techniques and could achieve 99 percent radon control. (P-15a, P-15b)

Response: Numerous radon control techniques are discussed in the BID, including adsorption on charcoal, cryogenic distillation, and scrubbers. None of the techniques mentioned by the commenter have been demonstrated for controlling radon from mines; thus, information is very sparse. The available information suggests that such controls are not viable for mines and/or entails very great costs.

Comment 5.3.7: We suggest that the land control standard be dropped from further consideration and that standards be based on either emission or dose rates. (G-19)

Response: See response to Comments 5.1.2a through c.

Comment 5.3.8: We agree that the Agency has properly rejected bulkheading, sealant coatings, activated carbon adsorption, mine pressurization, and backfilling as means of controlling radon emissions from mines. However, there are several inaccuracies in the assessment that should be noted, as these inaccuracies cause the Agency to overestimate the effectiveness of these methods, and to underestimate their costs. Specifically: Bulkheading is already used as extensively as possible for worker protection; sealant coatings can only be used on very limited areas of an underground mine; pressurization of deep mines will not work; and activated carbon adsorption of radon will not work in the moist atmosphere of a mine. Also, the reference mine used by the Agency fails to consider all sources of radon, and is not universally applicable to all types of underground mines. (I-3a, I-36b, I-47)

Response: See response to Comment 5.1.2.

Comment 5.3.9: At the public hearing, the EPA suggested that another means of control is to move the mine vents. Mines follow the ore body and mine vents are placed as necessary to bring in fresh air and exhaust radon to protect the miners. Moving the vents is therefore not feasible. (I-3b, I-22, I-23)

Response: EPA has withdrawn the proposed standard for reasons described in response to Comment 5.1.2. Thus, this comment is now moot.

Comment 5.3.10: The EPA suggestion, that placing stacks on mine vents is a practical way to reduce ground level radon concentrations, is neither practical nor effective. (I-47)

Response: See response to Comment 5.3.9.

Comment 5.3.11: The proposed rule is ambiguous with respect to government-owned land. The lands under the control of the Bureau of Land Management have restrictions, but not prohibitions, on erecting residences. Are such lands to be considered controlled or uncontrolled areas? (G-19)

Response: See response to Comment 5.3.9.

5.4 Proposed Limits

Comment 5.4.1a: The 0.2 picocuries per liter standard is a small percentage of the fluctuation in natural background and is unreasonably low. The concentration of radon in the U.S. Capitol ranges from 0.7 to 4.7 picocuries per liter. The radon monitoring program in the Ambrosia Lake region of New Mexico, before, during, and after shutdown and peeling of the mines showed no significant difference in radon concentration among the three periods. (G-25, I-3b, I-31, I-43b, P-1b)

Comment 5.4.1b: It is arbitrary and inconsistent for the EPA to propose a standard for uranium mines that is much lower than that for uranium mills. (I-31, I-37b, I-47)

Response (Comments 5.4.1a and b): Although the standard of 0.2 pCi/l represents a small increment of the naturally occurring indoor radon concentration, the health risks associated with these concentrations are relatively high, and the Agency believes that any increases in these concentrations from sources of emissions should be kept as small as possible. However, for the reasons described in response to Comments 5.1.2a through c, EPA has withdrawn the proposed standard.

EPA does not agree that monitoring data show no difference in the radon concentration in air when the mines were shut down. On the contrary, when the mines were shut down the radon concentration decreased. EPA's interpretation of monitoring data from the Ambrosia Lake region is that radon emissions from the uranium mines significantly increase the radon concentration in air near the mines.

EPA has not yet proposed a radon standard for uranium mills under the Clean Air Act. The need for such a standard is, however, now under consideration by the Agency. Because the factors considered by EPA in developing these standards may be different for uranium mills than for uranium mines, it would not be inconsistent in the values if the standard were not the same.

Comment 5.4.1c: The standard, to be credible, must be based on health effects and techniques capable of demonstrating compliance. There appears to be no data demonstrating any public health impairment at radon levels of 3 picocuries per liter, nor for occupational exposures to 30 picocuries per liter. (G-16)

Response: The Agency disagrees. The standard is based on expected health effects for radiation exposure at low levels. Our ability to detect or demonstrate these effects does not impact on the probability that the health effects estimates are correct. With techiques available to us at this time we cannot prove, or disprove, the effects of low levels of radiation exposure. The scientific consensus has always been that it is provident for radiation protection purposes to treat the estimated health effects as real ones.

Comment 5.4.2: By imposing such rigid standards, the EPA is discouraging the energy conservative nuclear industry and encouraging the tightening up of homes. This will increase public exposure to naturally-occurring radon. (I-31)

Response: The proposed standards did neither. Rather, they were designed to protect the public with an ample margin of safety from the effects of radionuclides emitted to the atmosphere from the facilities covered by the standards. See response to Comment 5.1.2.

Comment 5.4.3: The form of the standard should be that of a working level, because the potential dose is not from radon, but from the radon daughter products.

Response: See response to Comment 5.1.2.

Comment 5.4.4a: The standard should be 0.02 working levels which is consistent with the EPA's standards for inactive sites and Canada's standards for uranium mines and mills. Alternatively, the standard should not be less than 0.4 working level months. These recommendations are consistent with recommendations by the ICRP and NCRP and with the EPA approach used for nuclear fuel cycle operations. (G-24, I-3b, I-23)

Comment 5.4.4b: The standard should not be lower than 3 pCi/l for unrestricted areas. (I-17)

Comment 5.4.4c: If the standard were based on the traditional U.S. formula of restricting the maximum dose to the member of the public to one-tenth the dose permitted workers, the standard would be 0.4 WLM/year, or approximately 2 pCi/l. (I-17)

Response (Comments 5.4.4a through c): See response to Comments 5.1.2a through c.

Comment 5.4.5: The EPA should establish an annual emission limit of 1 Ci/yr. (P-15a)

Response: An emission standard of 1 Ci/yr would require large underground mines to reduce their emission by factors of 10^3-10^4. Such reductions cannot be achieved. See response to Comment 5.1.2.

Comment 5.4.6: The proposed limit, while quite restrictive, appears reasonable based on ICRP-26 recommendations concerning acceptable risk. Even though health effects cannot be accurately measured due to inadequacies in epidemiological methods, such low limits are needed to provide an acceptable level of risk. (G-20)

Response: See response to Comment 5.1.2.

Comment 5.4.7: Background varies from below 0.1 pCi/l to above 1.0 pCi/l. The 0.2 pCi/l limit above "background" will most often not be distinguishable from background radon as measured by available techniques. (P-1a, P-1b)

Response: EPA agrees that the 0.2 pCi/l cannot be distinguished from background. This is why compliance with the proposed standard was to be determined by calculating the radon-222 concentration using appropriate dispersion models.

Comment 5.4.8: The 0.2 pCi/l standard is too lax, and is inconsistent with the other proposed standards. (P-3a)

Response: See response to Comment 5.1.2.

Comment 5.4.9: EPA should establish work practice controls rather than land use controls for uranium mines. (P-3)

Response: See response to Comment 5.1.2.

5.5 Implementation

Comment 5.5.1: The EPA has suggested curtailing operations to reduce radon emissions. This is not only impractical, but in the EPA's proposed rule, par. 61.143(d), the source is to be treated as a year-round source, so that no credit would be given for reduced operation. (I-3b, I-43b)

Response: Long-term curtailment of operations, with ventilation systems shut down, will reduce radon emissions (see response to Comment 5.3.4) as much of the radon emanating from the surfaces of the mine will decay before reaching the atmosphere.

Comment 5.5.2: Achieving compliance with the proposed standard by purchasing additional land around the mines is not practical because:

a. The mine owners have no power of eminent domain and therefore cannot compel the owners to sell.

b. Even if an owner agreed to sell, experience indicates the price would be greatly inflated, and the total cost would be astronomical.

c. The Federal regulations governing the sale of Indian land make it difficult and in some cases impossible to acquire such land.

d. Federal and state agencies controlling land near mines would be under no compulsion to sell or lease this land to the mine owners.

e. The EPA offers no guidelines as to how neighboring mines should determine their 0.2 picocurie per liter boundary lines.

(G-24, I-22, I-23, I-31, I-43b, I-47)

Response: See response to Comment 5.1.2.

Comment 5.5.3: Demonstration of compliance with the proposed standard is virtually impossible because the proposed limit is only a small fraction of natural background. Compliance is therefore to be based on estimates of the boundary level concentration. These estimates are to be made using an unverified and questionable computer model. (G-24, G-25, I-22, I-23, I-26, P-1a, P-1b)

Response: See response to Comment 5.1.2.

Comment 5.5.4: Once the EPA sets the required standard in terms of emissions, compliance monitoring requirements should be set. These should include simultaneous measurements at all vents quarterly. In addition, records on total ventilation rates and maintenance practices taken to minimize emissions should be required. (P-15a)

Response: See response to Comments 5.1.2a through c.

Comment 5.5.5: The modeling method proposed by the EPA would allow radon from multiple sources to accumulate and exceed the regulatory limit which is based on a single source. This would be avoided if the EPA specified environmental monitoring (current field instruments can determine concentrations below the proposed limits) to demonstrate compliance. (G-20)

Response: EPA does not believe that compliance with the proposed standard can be determined by environmental monitoring. See response to Comment 5.1.2.

5.6 Costs

Comment 5.6.1: Section 112 of the Clean Air Act neither expressly requires nor precludes consideration of costs, and an interpretation that precludes consideration of costs is neither reasonable nor warranted. (I-22)

Response: See response to Comments 2.1.7a through 2.1.7i.

Comment 5.6.2a: The cost of installing activated charcoal beds as a means of removing radon from mine vent exhaust would be on the order of one billion dollars per mine, and the annual operating costs would be on the order of seventy five million dollars per year. Based only on annual operating costs, the cost per health effect averted per year is about one billion dollars. (I-47, P-15a)

Response: The Agency agrees that adsorption of radon on activated charcoal beds would be very costly. Such technology has not been demonstrated for mine applications, and the EPA has not considered it an available control technology for uranium mines.

Comment 5.6.2b: The EPA erred in using county tax assessments for its estimates of the cost of land in the Ambrosia Lake area. Estimates based on asking prices fall in the range of $1200 to $2000 per acre, not the average assessed value of $3.00 per acre. The actual fair market value of the land is about $70.00 per acre. (I-43b, I-47)

Response: The EPA did not rely solely on county tax assessments for its estimate of land costs. Land values were determined by using several data sources: (1) information from the respective county and state tax assessors' offices; (2) detailed assessed valuations from these offices and applying applicable assessment valuation to selling price ratios obtained from the U.S. Department of Commerce, Bureau of Census (1978); (3) estimates from local real estate agents; and (4) local newspapers. The valuations were based on surface usage and rights only, since mineral values would remain intact.

Land value calculations were then made for each privately held parcel within 5 km using two basic methods: (1) using full assessment data and applying appropriate ratios, or (2) using quoted local land values and multiplying by the number of acres and/or dwelling units. The higher value was used in our estimates. We believe our methodology gives a fair and accurate estimate of land costs.

Comment 5.6.2c: The EPA's assumptions regarding the costs of applying sealants are outdated and are much lower than estimates made by the Bureau of Mines. (I-3b)

Response: The cost estimates for applying sealant coatings are based on 1980 data from the Bureau of Mines. Recent data by PNL indicates the cost may be higher ($5.80 per ton of ore mined).

Comment 5.6.3: The costs of installing stacks are unreasonable and disproportionate to any public health benefit. In addition, the safety hazards to construction workers outweigh any potential hazards to some hypothetical nearby resident. (I-22)

Response: See response to Comment 5.3.10.

Comment 5.6.4: The EPA's proposed standards are not cost effective, in that real costs would be expended to benefit hypothetical people. (I-47)

Response: EPA is not considering standards to benefit hypothetical people. The proposed standard was based on protecting real individuals. As outlined in Table 5-13 of the BID, a study was conducted in January and February of 1983 to determine the population, type of ownership, and cost of land around 30 large uranium mines.

Comment 5.6.5: The EPA, in avoiding discussion of relative risks, fails to provide the perspective needed to see if the costs justify the benefits. (I-22)

Response: See response to Comment 2.6.7.

Comment 5.6.6: Imposition of this standard could drive domestic suppliers of uranium out of business, thereby forcing the nation to depend on foreign sources. This is inconsistent with the Atomic Energy Act and the EPA's regulatory impact analysis of environmental standards for uranium mill tailings at active sites. (I-47)

Response: It is not felt that this standard would have driven domestic suppliers of uranium out of business. On page 5-22 of the draft BID, it was estimated that the cost of land control for this standard would be only 1 percent of the cost of production. However, this comment has been rendered moot by EPA's withdrawal of the standard.

Comment 5.6.7: By ignoring combined techniques such as bulkheading and backfilling on ventilation requirements, the EPA has overstated the costs of controls. It neglects to consider that a carbon system is dependent on the bulkheading strategy used in connection with it. (P-15)

Response: EPA did consider the combined techniques of bulkheading and carbon absorption in our cost estimates. The cost estimate for carbon absorption by itself should not have been included. The costs are only accurate to order of magnitude.

Comment 5.6.8: Cost estimates for tall stacks at two existing mines spread over existing reserves show annual costs would increase by 6 percent at one and 23 percent at the other. (I-17)

Response: EPA agrees that the use of stacks on mine vents may significantly add to the operating cost of mines. See response to Comment 5.3.9.

Comment 5.6.9a: Purchasing land to form a buffer is either not feasible or prohibitively expensive. At the Schwartzwalder mine, an adequate buffer zone would cost 11 million dollars. At Cotter's Colorado Plateau mines, such a zone is not feasible since the surrounding land is federally owned. (I-17)

Comment 5.6.9b: EPA's proposed mandatory control requirement would force uranium companies to either close operations or pay existing owners windfall premiums to buy them out. (I-3)

Response (Comments 5.6.9a and b): See response to Comments 5.3.2a and 5.3.2b.

Comment 5.6.10: EPA's cost estimates are deficient because they fail to take into account the loss of worker efficiency. (I-3)

Response: It was not felt necessary to include a cost for the loss of worker efficiency in our estimates because EPA's costs are only approximate.

5.7 Other Comments

Comment 5.7.1: The EPA has illegally ignored the risks from surface and *in situ* uranium mining. The EPA's 1979 assessment of surface mining indicates risks of 1.3 in 1000. (P-15a)

Response: The Agency has not ignored the risks from surface and *in situ* uranium mining; the discussion of uranium mining in the BID includes both. Standards were not proposed for either of these technologies as the maximum ground level air concentrations of radon emitted from these activities are significantly lower than those which result from underground mining. Given the level of risk, and the unavailability of controls to reduce emissions from surface mining, the decision was made that no standard is necessary.

6.0 ELEMENTAL PHOSPHORUS PLANTS

6.1 Basis for the Standard

Comment 6.1.1: The health of the population of southeastern Idaho appears to be better than that of the country as a whole and has shown no deterioration during the 30 years that the Pocatello phosphorus plant has been in operation. Therefore, there is no need to limit the amount of polonium-210 in calciner off-gas. (I-2c)

Response: The expected risk from the Pocatello phosphorus plant is not great enough to be detected in the "spontaneous" cancer background in any epidemiologic studies that could be done. However, the fact that the increase cannot be detected by the means available to us does not mean there is no risk. Also see response to Comment 2.2.59.

Comment 6.1.2a: The EPA estimates that a person living one mile downwind of the Pocatello plant for 70 years would have a 1 in 10,000 chance of developing cancer related to the plant operation. This level of risk is insignificant when applied to the population of southeastern Idaho. (I-2c)

Comment 6.1.2b: The EPA has failed to demonstrate a health-related basis for regulating emissions of radionuclides from elemental phosphorus facilities. (I-20a, I-20b)

Comment 6.1.2c: The EPA has not shown that either maximally exposed individuals or populations living near elemental phosphorus plants are being exposed to a significant or unreasonable health risk from radionuclides. The modeling the EPA performed was too conservative and uncertain and the actual doses that people are receiving are vanishingly small. (I-39)

Response (Comments 6.1.2a through c): EPA conducted extensive additional emission testing at elemental phosphorus plants following issuance of the proposed standard. Based on information from these tests, EPA estimates that radionuclide emissions from calciners at these plants will cause about 0.06 fatal cancers in the population around these plants for each year of plant operation. About 80% of this population risk is caused by emissions from two plants: the FMC plant in Pocatello, Idaho and the Monsanto plant in Soda Springs, Idaho. The lifetime risk of fatal cancer to the "most exposed individuals" is estimated to be $1x10^{-3}$ (1 chance in 1000) at the Monsanto plant and $5x10^{-4}$ (5 chances in 10,000) at the FMC plant.

After consideration of these risks, and other pertinent information discussed below, it is the Administrator's judgment that the present record does not support a conclusion that regulation of elemental phosphorus plants is "necessary to protect the public health with an ample margin of safety," within the meaning of the Clean Air Act. Therefore, the proposed rule is withdrawn and the rulemaking is terminated.

EPA considers the risks to the "most exposed individuals" to be relatively high. If risk to the most exposed individuals were the only criterion for judgment, this relatively high risk might well have led to a decision to regulate. However, these individual risks must be weighed both against the low population risk (aggregate risk) and against other factors.

Adding additional controls to these plants will be extremely expensive measured against the limited public health benefits provided. The two plants involved are both located in a single state which makes the case for Federal action somewhat weaker than if there were a number of sources located throughout the country. Finally, a special subcommittee of EPA's Science Advisory Board (SAB) in a report issued last August stated that EPA's analysis in support of its proposed standards was not presented in a format that provides a scientifically adequate basis for regulatory decisions. EPA disagrees with this last comment; however, the Agency believes that the record as a whole does not support issuing this standard.

Comment 6.1.3: Even if radionuclide emissions from elemental phosphorus plants can be shown to be a significant health risk, they should not be regulated under Section 112. (I-20a, I-20b)

Response: See response to Comments 2.1.2a through 2.1.2j.

Comment 6.1.4a: The elemental phosphorus industry is operating within standards set by the NRC and the EPA for normal operation of the uranium fuel cycle (40 CFR Part 190), as acknowledged by the EPA in 48 FR 15087, April 6, 1983. These standards provide the public with an ample margin of safety. (I-20a)

Comment 6.1.4b: The EPA has exempted from regulation some source categories that emit higher levels of radionuclides than those proposed for elemental phosphorus. Uranium fuel cycle facilities and sources of high level nuclear wastes are permitted emission levels that result in annual doses of 25 mrem/yr to kidneys and lungs. If this provides an ample margin of safety for these sources, why is this not so for elemental phosphorus plants? (I-39)

Response (Comments 6.1.4a and b): Radionuclide emissions from several elemental phosphorus plants result in radiation doses to the lungs of individuals living near these plants which exceed EPA standards for uranium fuel cycle facilities (40 CFR 190). Nevertheless, for the reasons described in response to Comments 6.1.2a through c, the Administrator has determined that the present record does not support a conclusion that regulation of elemental phosphorus plants is "necessary to protect the public health with an ample margin of safety" within the meaning of the Clean Air Act.

Comment 6.1.5a: The EPA does not explain why it is sufficient to limit the emissions of elemental phosphorus plants to 1 Ci/y when available technology will permit greater reductions. The EPA also does not explain why the standard should apply only to large plants and not to small ones, when the only apparent significant difference among the plants is their size. (P-17)

Comment 6.1.5b: The EPA must set a standard based on curies per metric ton of phosphate rock production basis. This alternative was rejected with only the explanation "...this type of standard may require emission control retrofit by one or more additional plants even though their emissions of polonium-210 would be significantly less than 1 Ci/y." (P-17)

Comment 6.1.5c: An emission standard limiting emissions to a certain number of picocuries per ton of material processed seems more reasonable. (G-24)

Response (Comments 6.1.5a through c): EPA has withdrawn the proposed standard for elemental phosphorus plants for the reasons described in response to Comments 6.1.2a through c. Therefore, the issues raised in these comments have been rendered moot.

Comment 6.1.6a: The EPA has proposed an emission rate standard for polonium-210 of 1 curie per year. This rate is related to dose through a conservative, unrealistic modeling procedure. The emission rate by itself does not take into account the local population, meteorology, topology, or land use, all of which affect dose. (I-39)

Comment 6.1.6b: Concentrations of radionuclides in ambient air are more closely related to doses to persons than are emission rates. In addition, airborne radionuclide concentrations can be measured directly. Therefore, any standard for elemental phosphorus plants should be based on radionuclide concentrations in air. (I-39)

Comment 6.1.6c: There is an incongruity between the standards of emissions for radionuclides at phosphorus plants and the standards for exposure at the border of Federal facilities. The standard should be based on exposure to an individual in the population and the corresponding concentration that would produce this exposure. (G-14)

Response (Comments 6.1.6a through c): EPA proposed a direct emission limit for polonium-210 emissions from calciners at elemental phosphorus plants because the Act indicates a preference for this type of standard where practical. The Agency considered indirect emission standards in units of dose-equivalents or air concentrations for other source categories because in those cases a direct emission standard would have been extraordinarily complex. However, because EPA has withdrawn the proposed standard for elemental phosphorus plants (see response to Comments 6.1.2a through c), issues relating to forms of the standard are no longer relevant.

Comment 6.1.7a: The risk estimates prepared by the EPA are smaller than risks the average person accepts everyday. This includes such things as the risk of cancer from cosmic rays caused by living in Denver for two months or the risk of dying by electrocution. This statement takes into account the fact that health risks the EPA estimated due to emissions from phosphorus plants are upper limits. (I-20a)

Comment 6.1.7b: The doses estimated by the EPA are smaller than background levels and variations in background levels in the United States. (I-20a, I-39)

Response (Comments 6.1.7a and b): See response to Comments 2.1.11a through 2.1.11f.

Comment 6.1.8: There is no evidence of a relationship between cancer and employment at the FMC Pocatello plant in a study that covers 30 years. (I-20a)

Response: No attempt was made in the Background Information Document to assess occupational exposure at the FMC Pocatello plant. No exposure measurements were made for estimating occupational exposure. The CAA dictated concern over airborne emissions to the environment, not occupational conditions.

Comment 6.1.9: In the report of April 6, 1983, the EPA stated that the emission of radionuclides greatly increases the risk of lung cancer to residents living near producers of elemental phosphorus. To the best of the commenter's knowledge, no such health related problems have been reported. (I-2b, G-14)

Response: See response to Comment 6.1.1.

6.2 Dose and Risk Calculations

Comment 6.2.1: Since only two plants appear to be affected by the proposed regulations and since both of these plants are in southeastern Idaho, a more reasonable approach to assessing the need for emission limitations would be to use site-specific information, including airborne radioactivity measurements, measurements of radionuclide content of locally grown foods, and actual consumption rates of locally grown foods. Monsanto believes that this approach would produce realistic results well below the EPA's estimated values. (I-39)

Response: The Agency agrees that site-specific information is desirable in developing standards for elemental phosphorus plants. Radionuclide emission rates and particle size distribution measurements were made at these facilities and are presented in the final BID. Most of the environmental measurements suggested are related to the ingestion pathway which is a minor contributor to the risk from polonium-210 from these facilities. EPA agrees that measurement of environmental airborne concentrations of radionuclides would be desirable to confirm predicted concentrations based on models. EPA will consider doing this in an upcoming study of the area.

Comment 6.2.2: Even the conservative EPA estimated doses do not represent a significant risk because they are well below the Radiation Protection Guide for whole body dose of 500 mrem/yr. (I-39)

Response: EPA does not believe that current FRC guidance and NRC policy of limiting exposure to individuals to 500 mrem/y whole body and 1500 mrem/y to any organ protects public health with an ample margin of safety, within the meaning of the CAA. EPA estimates that a person receiving 500 mrem/y to the whole body over a lifetime would have an added potential fatal cancer risk of about 1 in 100 due to the radiation exposure. However, for the reasons described in response to Comments 6.2.1a through c, the Agency has decided to withdraw the proposed standard.

Comment 6.2.3: For the prime radionuclide (polonium-210) of interest to EPA regarding emissions from elemental phosphorus plants, EPA inexplicably ignores entirely the small body of scientific studies that is the only known source of the health effects of polonium-210 in humans and animals, as well as the sole recommended level for human exposure.

Response: The commenter is in error. The Agency used ICRP 30 metabolic and dosimetry data (Background Information Document, Volume I, Chapter 7). ICRP-30, Part 1, (Ann. ICRP, Vol. 2, No.3/4, 1979) lists the same references listed by the commenter as appropriate. These were not used by ICRP or EPA for risk estimates.

Risk estimates based on BEIR-3 data were used in development of the Background Information Document. The ICRP limits are based on occupational exposure and are not applicable to the general population.

It may be noted in passing that the data base (references) listed in ICRP 30, Part 1, is by no means exhaustive. Other references include "Metabolism and Biological Effects of an Alpha Particle Emitter, Polonium-210," J.N. Stannard and G.W. Casarett, editors, Radiation Research, Supplement 5, 1964; "Effects of Polonium-210 on the Organism" by B.B. Moroz and Yu. D. Parfenov; Adomizdat, Moscow, 1971, (AEC-translation-7300, 1972); L.M. Scott and C.M. West, Excretion of 210-Po Oxide Following Accidental Inhalation, Health Physics 28: 563-565, 1975; J.F. Stara, et al., Comparative Metabolism of Radionuclides in Mammals: A Review, Health Physics, 20: 113-137; 1971; Sections in UNSCEAR publications of 1972, 1977, and 1982.

Unfortunately these studies, reports, and reviews provide data only on metabolism, dosimetry, and acute effects. Long-term effects (e.g., cancer) at low doses must be estimated using models.

6.3 Control Technology

Comment 6.3.1a: A preliminary analysis shows that it will be technologically impossible for FMC to meet the proposed standard. (I-20a, I-20b)

Comment 6.3.1b: The EPA has not justified its determination that high energy venturi scrubbers, rather than fabric filters, are the most effective available technology. It has ignored the statement in the BID that fabric filters are currently in use "... in more difficult operations such as asphalt plants...." It is inappropriate to dismiss the application of controls used successfully in other similar applications when promulgating regulations under Section 112. (P-17)

Comment 6.3.1c: The EPA has failed to provide any data on particulate size in its discussion on control technology. Without such data, it is impossible to comment on control efficiency and cost. (I-39, G-14)

Comment 6.3.1d: The EPA has not demonstrated that at a commercial scale elemental phosphorus plant there is control technology available that will enable nodulizing kilns to meet the proposed emission limit. The statement that a "high energy venturi scrubber is expected to be at least 98 percent efficient for polonium-210 removal and reduce emissions of this radionuclide for a large plant to less than 1 Ci/y" is unsupported. (I-39)

Comment 6.3.1e: Applying generic or typical emission control performance efficiencies to nodulizing kiln/calciner emissions for the purpose of determining polonium-210 removal efficiencies is not valid. There is no indication that EPA took particle size distribution into account in its analysis. Since the polonium-210 volatilizes and recondenses, it is reasonable to assume that it is concentrated in the smaller particulates. There are, however, no data that define the concentration of polonium-210 versus particle size. These data are essential in evaluating emission control effectiveness. (I-39)

Comment 6.3.1f: In Unit V.C. (48 FR 15085), the EPA estimates that the existing spray towers control particulate emissions to 0.5 to 1.0 pounds per ton of rock processed. Based on the estimate that venturi scrubbers will reduce this to 0.1 pounds per ton, the EPA concludes that polonium-210 emissions will be reduced accordingly and the 1 Ci/yr limit attained. However, emission data collected by Monsanto taken to show compliance with state emission limits indicates that the spray towers reduce emissions to 0.0095 and 0.0188 pounds per ton. Based on this, the use of venturi scrubbers will have little effect on polonium-210 emissions. (I-39)

Response (Comments 6.3.1a through f): To obtain additional information, EPA conducted emission testing of calciner off-gases at three elemental phosphorus plants. The purpose of this testing was to measure the radionuclide emission rates in the calciner off-gas streams and to determine the particle size distribution of the radionuclides in these streams. Using this emissions data and plant specific off-gas stream characteristics, EPA has reevaluated the costs and effectiveness of control equipment for reducing polonium emission from calciners at elemental phosphorus plants. (See Section 6.3.6 of final BID).

Comment 6.3.2: The EPA should require the use of fabric filters on sources other than calciners in elemental phosphorus plants. (P-17)

Response: Since radionuclide emissions from calciners will not be regulated under the CAA (see response to Comments 6.1.2a through c), regulation of these less significant sources is not justified.

Comment 6.3.3: Emission data collected by the EPA at three elemental phosphorus plants is not valid. Several statements from the three sampling reports indicate that there were serious problems with the validity of the data, due both to sampling and analytical problems. (I-39)

Response: EPA has reviewed the emission data cited in this comment and believes the data to be valid, reliable, and adequate for use in determining the need for emission standards. EPA has supplemented this data with additional emission testing. These additional tests have confirmed the validity of the original data.

Comment 6.3.4: Polonium-210 is harmful when the particulates to which it is attached are inhaled or ingested. If the polonium-210 is preferentially attached to the smallest particulates, the removal efficiency for various types of pollution control equipment estimated by the EPA may be high. However, since a large percentage of inhaled particulates in the 0.5 to 1.0 micron range are expelled when a person exhales, it is possible that the smaller particulates are less of a radiation hazard. (I-2c)

Response: Recent emission test data has indicated that polonium-210 in calciner off-gas streams is mostly associated small particles. More than 90 percent of the polonium is associated with particles less than 1 micron. Based on this new data, EPA has concluded that its original estimates of the effectiveness of wet scrubbers for reducing polonium-210 emissions were high. EPA has reevaluated the effectiveness of control equipment based on this new information (see response to Comments 6.3.1a through 6.3.1f). However, contrary to the comment, the smaller particle size distribution will result in a higher radiation dose to the lung not a smaller dose.

6.4 Proposed Limits

Comment 6.4.1: The EPA's proposed emission standard (limiting whole body doses to about 10 mrem/yr) for elemental phosphorus plants, based on available and reasonable control technologies, is laudable. (G-21)

Response: This comment has been rendered moot by EPA's decision not to set standards for elemental phosphorus plants.

Comment 6.4.2: The emission limits that the EPA is proposing would produce a dose to the hypothetical maximum individual that is several orders of magnitude smaller than limits set by such groups as NCRP and ICRP as well as that recommended in several studies. In addition, it is less than one percent of the current standard set by the State of Idaho for emissions from elemental phosphorus plants. (I-20a)

Response: Response to this comment is addressed in responses to Comments 6.1.2a through c and 6.2.2.

6.5 Implementation

Comment 6.5.1: The EPA should review how the standard will be enforced and what the impact on state agencies will be. (G-14)

Response: This comment is no longer applicable since EPA has withdrawn its proposed standard.

Comment 6.5.2a: The procedure given in 48 FR 15090 for determination of polonium on air filters contains deficiencies. The procedure should be carried out using a polonium tracer along with alpha pulse height analysis spectroscopy using a silicon surface barrier detector. (I-39)

Comment 6.5.2b: Determining the procedure efficiency as described in step 4.3.3 (48 FR 15090) with a "clean filter" will not give the efficiency of a "real world" dirty filter. (I-39)

Comment 6.5.2c: In step 4.1.1, a statement should be added so that the analyst will use care throughout the procedure to avoid polonium loss through volatilization. (I-39)

Comment 6.5.2d: Samples should be analyzed within a few weeks of collection. Since lead-210 decays to polonium-210, not knowing the amount of lead-210 present leads to uncertainty in back calculating the amount of polonium-210 originally present. (I-39)

Comment 6.5.2e: In step 4.2.1, the statement "add 200 ml of ascorbic acid" should probably read 200 mg of ascorbic acid. (I-39)

Response (Comments 6.5.2a through e): EPA acknowledges the advantages of using a polonium tracer and alpha spectroscopy for the analysis of polonium-210 in filters. EPA also agrees with the suggestions in Comments 6.5.2b through e.

Comment 6.5.3: Problems that have been identified with procedures for stack sampling for polonium-210 raise the question of whether or not reliable measurements can be performed in order to show compliance. (I-39)

Response: EPA has carried out additional emission testing at elemental phosphorus plants for polonium-210. This testing showed that reliable sampling and measurement of polonium-210 can be made when proper facilities for such sampling exist.

Comment 6.5.4a: It is not feasible to conduct emission tests as specified using Test Methods 1, 2, and 5 of part 60 at Monsanto's plants. (I-39)

Comment 6.5.4b: Due to large stack diameters and short stack height, it is physically impossible to meet the upstream and downstream spacing requirements contained in the EPA methods for determination of sampling location. (I-39)

Comment 6.5.4c: Handling of fragile sampling equipment with the required long probe at heights in excess of 100 feet where there is no working area would be difficult if not impossible. (I-39)

Comment 6.5.4d: The gas flow in the demister stacks is cyclonic, thus making isokinetic sampling impossible. In fact, it states in the test methods that the method cannot be used if the flow is cyclonic. (I-39)

Comment 6.5.4e: In order to comply with state regulations on particulate emissions, Monsanto has developed modified methods that provide representative results. Section 61.154 of the proposed regulations should be amended to allow state-approved methods when EPA methods are not valid. (I-39)

Response (Comments 6.5.4a through e): EPA recognizes that the existing facilities at the Monsanto plant do not allow the use of standard EPA sampling methods. However, even through EPA has withdrawn the proposed standard for elemental phosphorus plants, the Agency still believes that the Monsanto, Soda Springs, Idaho, plant should install the necessary facilities to allow for emission testing using standard EPA stack sampling methods.

6.6 Costs

Comment 6.6.1: Implementation of the proposed standard will probably cause FMC to become non-competitive in the elemental phosphorus market. (I-2b)

Response: Our analysis indicates that FMC has a relatively large margin between selling prices and production costs. Our analysis also indicates that although the use of additional control equipment would cut into the economic rent that FMC currently enjoys, it would not endanger the viability of its operations (see EPA-520/1-84-025).

Comment 6.6.2: Even if it is possible for FMC to comply with the proposed rule, the cost, because of FMC's unique process, may be much greater than that predicted for the EPA's model plant. (I-20a, I-20b)

Response: EPA has evaluated the cost for various alternative control systems from reducing polonium-210 emissions from the FMC plant based on plant specific information (see response to Comments 6.3.1a through f.) These costs are shown on Section 6.3.6 of the final BID. Additional comments on costs for these control systems are presented in Volume II of the Response to Comments.

Comment 6.6.3a: Even based on the conservative risk estimates, the proposed rule is not cost effective. No rules have been proposed for other industries due to cost effectiveness even though the costs are in the same range as those for the elemental phosphorus industry. (I-39)

Comment 6.6.3b: Compliance with the proposed standard would require the expenditure of considerable capital and other resources without producing a significant reduction in risk. It is unreasonable to expend the resources when estimated doses are below natural background and 30 times less than doses considered safe (i.e. Radiation Protection Guide). (I-39)

Comment 6.6.3c: The basis for the EPA's decisions regarding cost effectiveness is not well defined and the results are inconsistent. (I-39)

Comment 6.6.3d: The cost per fatal cancer avoided for the elemental phosphorus industry should be higher, since the risk is overestimated by a factor of 10 or more and the cost of compliance has been underestimated.

Monsanto estimates the capital and annual operating costs for venturi scrubbers to be $5 million and $2 million, respectively, while the EPA estimates are $3 million and $1.5 million. (I-39)

Comment 6.6.3e: The EPA has not performed an adequate cost/benefit analysis for the control of polonium-210 and lead-210 emissions from elemental phosphorus plants. (I-39)

Response (Comments 6.6.3a through e): EPA did consider costs of alternative standards in evaluating the need for standards for elemental phosphorus plants. This information is contained in the BID.

Comment 6.6.4a: The proposed rule is defined as a "Major Rule" under Executive Order 12291, particularly because it would result in a major increase in costs or prices and would have "significant adverse effects on competition, employment, investment, productivity, innovation, or the ability to compete with foreign-based enterprises..." (I-39)

Comment 6.6.4b: The proposed rule would result in significant economic dislocations to the elemental phosphorus industry which would affect costs, prices, competitiveness, investment, productivity, and innovation, and would seriously affect Idaho's ability to compete in domestic markets with either domestic or foreign producers. (I-2a)

Comment 6.6.4c: It is appropriate to perform a full regulatory impact analysis of the proposed rule under Executive Order 12291, even if the annual effect on the national economy is less than $100 million. Such an analysis is also suggested under the Executive Order if a major increase in costs or prices results for consumers, individual industries, Federal, state, or local government agencies, or geographical regions. (I-2a, I-2d)

Response (Comments 6.6.4a through c): EPA has carried out a regulatory impact analysis of various alternative standards for the FMC and Monsanto elemental phosphorus plants (EPA-520/1-84-025). These plants were analyzed because they had the highest radionuclide emissions and were the only plants affected by the proposed standard. This analysis showed that installation of control equipment to reduce polonium emissions would not endanger the economic viability of the plants.

6.7 Other Comments

Comment 6.7.1: It is clear from the discussion in Unit V (48 FR 15084) of the Supplementary Information that the EPA intends to regulate only polonium-210 emissions from kilns/calciners. However, Section 61.152 of the proposed regulations states "Emissions of polonium-210 to air from sources subject to this subpart shall not exceed 1 curie in a calendar year." The phrase "sources subject to this subpart" is not defined in Subpart V. It should be defined as nodulizing kilns and calciners. (I-39)

Response: This comment is no longer applicable since EPA has withdrawn the proposed standard.

7.0. COAL-FIRED BOILERS

7.1 Basis for the Standard

Comment 7.1.1a: Existing data show that coal-fired boilers do not emit sufficient radionuclides to cause a high risk to the public. A risk to public health lower than comparable risks experienced in daily life cannot be said to pose a high risk. (G-15, I-4b)

Comment 7.1.1b: Section 112 authorizes regulation of emissions causing high risk. It was not intended to require regulation of "insignificant" emissions of risks or possibilities of harm. Emissions from coal-fired boilers do not produce a discernible risk, when one defines discernible risk as statistically different from background. (I-4b, I-44)

Comment 7.1.1c: The Administrator should consider factors such as the degree to which the substance is already regulated, whether existing regulations lead to the desired reductions, and whether further regulations could result in other public health risks as great or greater than posed by current emissions. Regulating radionuclide emissions from coal-fired boilers would not decrease (and might even increase) public health risks. (I-4b)

Comment 7.1.1d: Further reduction in particulate emission levels from levels mandated by existing regulations is not justified either economically or from the reduction in health risks. Particulates are among the most stringently regulated substances under the CAA. (G-15, I-4a, I-4b, I-53)

Comment 7.1.1e: Based on information contained in a report entitled "Behavior and Impacts of Radionuclides from Western Coal-Fired Power Plants," we believe the Agency has properly concluded that emission standards for coal-fired boilers are not needed. (G-15, I-9, I-24, I-51)

Response: (Comments 7.1.1a through e): The commenters agree with the EPA determination that standards for coal-fired boilers are not appropriate. The Agency reached this conclusion by considering the following criteria:

1. The radiation dose and risk to nearby individuals;
2. The cumulative radiation dose and risk to populations in the vicinity of the source;
3. The potential for radiation emissions and risk to increase in the future;
4. The availability, practicality, and cost of control technology to reduce emissions; and
5. The effect of current standards under the Act or other applicable legislative authorities.

Applying these criteria to coal-fired boilers, it is EPA's finding that the existing and proposed EPA standards for particulate emissions also limit radionuclide emissions and provide an ample margin of safety from radionuclides for the following reasons:

- Individual and population risks due to radionuclide emissions from coal-fired boilers are not unreasonable compared to the cost and feasibility of reducing risks more.

- These emissions and risks are likely to decrease in the future, and there is not a large radionuclide inventory that could be rapidly released to the environment.

- For industrial boilers, planned NSPS revisions would require new, modified, and reconstructed industrial boilers capable of 15 MW heat input to employ control technology in the form of electrostatic precipitators or fabric filters. This will reduce radionuclide emissions along with particulate emissions.

- For utility boilers, New Source Performance Standards require the application of Best Available Technology for particulate emissions from new sources; no technologically feasible controls are available beyond this for new boilers.

- Existing particulate emission limits for utility and industrial coal-fired boilers established by State Implementation Plans require the application of various degrees of technology for existing sources. Even the most lenient of these standards require the use of particulate control technology. It is not practical to require further control technology beyond this in view of the small increment in estimated health benefit in relationship to extremely large costs.

Comment 7.1.2a: Regulation of a subcategory of coal-fired boilers is unnecessary because over 99 percent of utility boilers have particulate control technology and no abnormally high radionuclide coals are being burned by utilities. The one percent of boilers that are uncontrolled are very small, older plants with low capacity factors that produce insignificant radionuclide emissions. (I-4b)

Comment 7.1.2b: The EPA is required by law to determine an adequate margin of safety for radionuclide emissions from coal-fired boilers. If a pollutant causes human cancer, the EPA has a duty to eliminate that risk. If NSPS controls are enough to achieve a level of health protection that provides an ample margin of safety for worst case (highly contaminated) coals, the EPA should so specify. (P-15a)

Comment 7.1.2c: The EPA is obliged to study and consider regulating coal-fired boilers whose emissions create above average risks or burn coals with a high radioactivity content. (P-3b, P-17)

Response (Comments 7.1.2a through c): Boilers using coal having a radionuclide content significantly above average or that operate in a manner to cause elevated emission of radionuclides could constitute a subcategory of boilers where a radionuclide emission standard might be necessary. This was the subject of a study by the Los Alamos National Laboratory which was completed after the Federal Register Notice of April 6, 1983. A report of this study, filed in the Docket (A-79-11, doc. # E-9), concludes that there is no commercially available coal which has significantly elevated concentrations of radionuclides, and no boiler has been identified which emits levels of radionuclides that are higher than emission levels of the model plants upon which EPA has based its determination that additional standards are not needed for radionuclides. Therefore, EPA has not proposed emission standards for radionuclides for any subgroup of coal-fired boiler.

Comment 7.1.2d: The EPA should more closely study potential exposure due to plants burning coals with higher than average concentrations of radioactive elements. (P-6)

Comment 7.1.3a: Coal contains numerous trace elements. The EPA should evaluate risks using a cumulative risk from all elements and compounds, not just radionuclides. The EPA approach ignores the total risk to the population from burning coal. (P-17)

Comment 7.1.3b: Controlling particulates would benefit reduction in trace pollutant emissions, visibility, soiling index, and meeting NAAQS for particulate matter. The EPA cannot declare the risks de minimus without a comprehensive analysis of risks from all hazardous pollutants in a coal-fired boiler's particulate emissions. (P-15a, P-17)

Comment 7.1.3c: The EPA must consider controlling particulates further because they contain four listed hazardous pollutants (i.e., radionuclides, arsenic, beryllium, and mercury). (P-17)

Comment 7.1.3d: Any reduction in trace elements resulting from standards to limit radionuclides would be insignificant in terms of the overall emissions of such elements from all sources. (I-4b)

Response (Comments 7.1.3a through d): EPA agrees that a comprehensive analysis of all risks due to all hazardous pollutants from coal-fired boilers should be considered when particulate emission standards are justified. However, methodology for performing such a calculation has not yet been developed. EPA did not declare the risks due to radionuclides de minimus. EPA only determined that, given the high costs and other emission control limits for particulates, additional particulate emission control limits would not be proposed.

Comment 7.1.4: The EPA placed undue emphasis on cost of control technology rather than health impacts. Section 112 requires health-based standards, without undue emphasis on cost. (P-3a, P-3b)

Response: EPA considered a number of factors including: (1) the radiation dose and risk to nearby individuals, (2) the cumulative radiation dose and risk to populations in the vicinity of the source, (3) the potential for radiation emissions and risk increase in the future, (4) the availability, practicality, and cost of control technology to reduce emissions, and (5) the effect of current standards under the Clean Air Act or other applicable legislative authorities. The basic conclusion is that existing and proposed standards to control particulates provide an ample margin of safety to protect the public health from radionuclides emitted by coal-fired boilers and that additional controls would be extremely expensive and of small comparative benefit. EPA believes it has not placed undue emphasis on cost and that its conclusions are primarily health-based.

Comment 7.1.5a: We do not agree with the EPA's premise, as presented in the FR notice and the BID, that no standards are needed for coal-fired boilers. We do not agree with the premise that particulate emissions are sufficiently controlled to keep radionuclide emissions at acceptable levels and that increased control would not be cost-effective. (G-21)

Comment 7.1.5b: Although the New Source Performance Standards for utility boilers greater than 250 MMBtu/hr do require best available control technology, this limit only applies to units constructed after September 19, 1979. Thus, most large boilers are exempted, and industrial boilers constructed since 1971 are allowed emissions more than three times this limit for utility boilers. (G-21)

Comment 7.1.5c: Smaller industrial boilers, approximately 67 percent of total capacity, are not covered by New Source Performance Standards. Although reference is made to draft proposed limits that reportedly reduce emissions and corresponding doses to less than 1 mrem/yr, the draft limits are not given, and the 1 mrem/yr figure is not supported by any calculations. Thus, much appears to depend on an unknown standard, not yet adopted, that will only apply to new sources. Standards should be designed to control emissions from existing as well as new sources. (G-21)

Comment 7.1.5d: The statement that, under current regulatory programs, emissions should slowly decrease as old boilers are replaced ignores the facts that the NSPS for most industrial boilers is unknown (and may be set as high at 0.2 lb/MMBtu), and that increases in overall coal use could substantially cut into any reduction in emissions due to retirements. (G-21)

Comment 7.1.5e: We support the EPA's decision not to propose additional standards for coal-fired boilers. We concur in your assessment that additional controls would not be cost-effective, and that there is no potential for overall emissions to increase due both to limited amounts of radionuclides in coal and the beneficial effects of retiring older units. (I-48, I-50)

Comment 7.1.5f: EPA did not adequately justify its decision not to impose standards on coal-fired boilers. (P-6)

Response (Comments 7.1.5a through f): Since the Background Information Document was published, a report prepared for EPA by Radian Corporation (See Docket A-79-1, Document #II-E-6-7) updates information on controls used on coal-fired utility boilers. According to the report, all coal-fired utility boilers currently use some form of particulate control device. Boilers accounting for over 90 percent of the total generating capacity are controlled by electrostatic precipitators. A large number of boilers are controlled with mechanical collectors only, but these are generally small units with generating capacity of less than 25MW. Industrial boilers not covered by New Source Performance Standards are regulated by State plans.

Total health effects due to radionuclide emissions from coal-fired boilers are low as the result of these particulate emission controls. These estimates are based on current information about total particulate emissions from utility boilers and from industrial boilers. This information and the high cost to reduce emissions further, weighed heavily in the decision not to regulate coal-fired boilers for radionuclide emissions.

Comment 7.1.6: The EPA should examine emissions resulting from ash collection and disposal. (P-4)

Response: Solid waste management practices at plants burning coal prevent airborne radionuclide emissions from ash collecton and disposal. This source of emissions of radionuclides is insignificant compared to emissions from the stack.

Comment 7.1.7: The EPA should note that some fly ash is more radioactive than normal building material and should be tested before being sold as a concrete additive. (G-4, P-5)

Response: Since this comment refers to fly ash that is collected by control devices and does not constitute an air pollutant, it would be more appropriately considered in other proceedings.

7.2 Dose and Risk Calculations

Comment 7.2.1: EPA's data bases on particulate emissions and control technology are out-of-date. Less than 0.1 percent of total generating capacity (representing 1.1 percent of boilers) have either no controls or have not reported controls. National particulate emissions are 20 percent lower than the value reported by EPA. (I-4b)

Response: Some of the data used in the Background Information Document have proved to be out-of-date. A report recently prepared for EPA by Radian Corporation (See Docket #A-78-11, Document #II-E-6-7) updates these data. In the BID, EPA assumed some utility boilers have no controls; however, the recent data indicate, in fact, all coal-fired utility boilers have some particulate controls. This change does not affect EPA's determination not to propose standards for utility boilers.

The total particulate emissions from all utility boilers of 0.9 million metric tons per year used in the Background Information Document is a recent estimate based on current data by EPA's National Air Data Branch, Monitoring and Data Analysis Division, in November, 1982. This remains EPA's best estimate.

Comment 7.2.2a: The radionuclide content of coal will tend toward the average value for coals because of the large tonnages burned. The radionuclide content of coal generally is not region nor coal-type dependent. Claims that high radionuclide content coal exists are unfounded. (I-4b)

Comment 7.2.2b: The radioactive content of coal is highly variable. This variability is well established and should be explicitly addressed in the standard-setting methodology. A more realistic (lower) value for fly ash radioactivity should be used. (G-15)

Comment 7.2.2c: The concentrations and ratios of radionuclides in fly ash were found to be similar to those used by the EPA and are highly variable. The EPA assumption of 9 pCi/g of U-238 in fly ash and a 100 mCi/yr source term are conservative, upper bound estimates of radionuclide emissions from existing coal-fired power plants. The total U-238 emission rate for all coal-fired power plants is probably half or less than half that value. (G-15, I-4b, I-48, I-51)

Response (Comments 7.2.2a through c): A draft of a report prepared for EPA by the Los Alamos National Laboratory (See Docket #A-79-11, Document #III-B-9) confirms the comment on the variability of radionuclide content of coal and that the radionuclide concentration in the coal of a specific plant will tend toward the national average value because of the large amounts of coal that are burned. EPA asked specifically when the determination was proposed if anyone knew of coal-fired plants burning coal with elevated radionuclide content. No examples were provided. EPA contractors have looked for coal-fired plants burning coal high in radionuclide content above the average and have not found any.

However, the concentration of uranium-238 in fly ash is highly dependent on particle size which is, in turn, dependent on the operating characteristics of a specific plant; the smaller the particle size the higher the concentration will be. EPA's choice of 9pCi/g is an average of values for various particle sizes given in the open literature. It is not considered to be upper bound.

The uranium-238 source term for the reference utility boiler of 100 mCi/y is not meant to be representative of emissions from a typical boiler, but rather an estimate of the largest emission levels likely to be encountered. It is used to establish a relationship between radionuclide emissions and dose and risk of health effects. This relationship is also used with the industry's yearly particulate emission rate to determine total health effects. Therefore, EPA sees no reason to lower its estimate of total uranium-238 emission rates or its estimate of health effects.

Comment 7.2.3: There is no consideration of natural sources, including radioactive dust, contributing to cancers. Natural dust bears radioactivity very close to the activity of the coal burned. (I-4b)

Response: There is no need to consider natural sources including dust. The risk estimates for cancer are attributable risks. That is, the models and calculations consider only a single source of radioactivity and carry through to estimation of the cancer risk attributable to that single source. While risks from various single sources can be summed to get an estimate of total risk, each risk estimate is independent and can be considered or discussed that way.

The risks addressed in the Background Information Document are for the sources as described. So the risk for coal-fired boilers addresses only that source of radioisotopes.

Comment 7.2.4a: Both the AIRDOS EPA and DARTAB/RADRISK models predict maximum dose commitments using built-in conservative assumptions. Predicted doses and risks to the maximum individual are far above what any individual will ever experience. The analysis should emphasize doses and risks to average individuals and to the population at risk. (G-15, I-4b, I-48)

Comment 7.2.4b: The EPA's dose estimates are overly conservative, upper-bound values. The EPA used multiple conservative assumptions in their analysis, typically using the maximum value found as the average value for modeling. As a result, the health effects from coal-fired plants are actually much lower. A more realistic risk value from coal-fired boilers is an upper-bound estimate of 0.2 to 0.6 effects per year. (I-4b, I-48, I-50)

Response (Comments 7.2.4a and b): EPA has developed its dose and risk models using reasonable parameters and assumptions. It did not use overly conservative upper-bound values. Use of these models to predict doses and risks to nearby individuals and to the regional population is the usual procedure. Calculating the dose and risk to the average individual living within an 80 kilometer radius of a facility does not provide the most useful information for determining if standards are need. While recognizing that there is a large uncertainty in estimating risks, EPA considers 1 to 2 health effects per year to be a reasonable estimate of population risk.

Comment 7.2.5: Risk assessments by the EPA could be improved by using: 1) better information on dose transfer factors; 2) a more realistic period for surface build-up of radionuclides reflecting the actual useful life of power plants; and 3) more realistic plume rise and dispersion characteristics. (I-4b, G-15)

Response: EPA considers the present models adequate to predict dose and risks for the purpose of determining that standards are not necessary. The refinements suggested by the commenters are not judged to change our estimates of dose and risk by amounts large enough to alter our conclusions.

Comment 7.2.6: In urban areas, the exposure due to inhalation may be greater than the dose due to ingestion. Population doses are similar to those for persons exposed to routine radiation releases from nuclear power plants. (P-1a, P-1b)

Response: EPA's studies of the reference utility boiler as the source term situated in urban, suburban, rural, and remote locations show that inhalation was the most significant pathway for population dose.

Population doses from coal-fired boilers are not similar to those from routine operation of nuclear reactors. Coal-fired boilers cause the irradiation of lung tissues with alpha particles, while nuclear reactors cause irradiation in other ways. Nuclear reactors are regulated for radionuclide emissions because they have the potential for releasing large quantities of radioactivity, far larger than coal-fired boilers.

Comment 7.2.7: Models used in performing risk assessments are just state-of-the-art type models and have inherent sources of error. The models used have not been verified for real-world situations. (G-15)

Response: The commenter is partially correct. Models used for risk assessments of radionuclide emissions from coal-fired boilers have not been specifically verified for coal-fired boilers. These models have been developed for releases of specified radionuclides from any point source. On this basis, the models have been verified. In EPA's opinion the use of these models is appropriate in determining the need for regulating the release of radionuclides from coal-fired boilers.

Comment 7.2.8a: The Teknekron report (EPA) did not use the conservative assumptions required for regulating with an ample margin of safety. It did not address genetic defects or birth defects. The reference boiler assumed some features characteristic of new boilers rather than older boilers. Particulates were not characterized correctly either for particle size distribution or collection efficiency. (P-3b)

Comment 7.2.8b: The EPA uses average boiler emission rates in its analysis. This is insufficient under the Clean Air Act mandate. The EPA must evaluate emissions that create above-average risks. (P-17)

Comment 7.2.8c: The assessment of emissions from coal-fired boilers is not based on worst-case scenarios. Indeed, the stack heights used for the reference boilers may represent a better than the average case. NESHAPS should be set for worst case, not the average case. (G-21)

Response (Comments 7.2.8a and c): EPA uses procedures that will result in dose estimates that are realistic, then, based on these estimates, determines whether there is an ample margin of safety. The calculations presented in the Background Information Document are new calculations made by EPA and not by Teknekron, Inc.

Genetic effects were not explicitly discussed in the Background Information Document for coal-fired boilers because compared to the somatic effects they are smaller in number.

Particle size ranges from boiler stacks are not known sufficiently to determine average size ranges for the reference boiler. Therefore, a default value was assumed, as recommended by the International Commission on Radiological Protection, whose lung model we are using.

Comment 7.2.9: Why is there no discussion in the Background Information Document of why the predicted dose rates given in the December 27, 1979 announcement of the addition of radionuclides to the NESHAPS list (44 FR 76738) are no longer valid? (G-21)

Response: The intent of the Background Information Document is to present current and best available information. Since December 1979, several studies were completed which update and supersede some of the information previously published.

Comment 7.2.10: Contrary to assertions made, the EPA model does account for the effect of scrubbers on radionuclide emissions, and is extremely conservative with respect to source term and other parameters such as particle size, plume rise, environmental accumulation, shielding, terrain, lung classification, assessment area, and population. (I-4b)

Response: The source term used in the EPA model considers the amount of radioactivity emitted to the environment from the stack of the reference boiler. Emission controls are thus accounted for.

EPA has not intentionally used conservative parameters in its model, but has, in its opinion, used representative values to provide a realistic estimate of dose and risk.

Comment 7.2.11: A realistic assessment of dose shows the EPA estimate is high by an order of magnitude. (I-4b)

Response: Since it is the commenter's opinion that EPA used high, upper-bound values for particulate emissions and radionuclide content of coal ash, and then used these values in a model having built-in extremely conservative parameters, it is not surprising that EPA's dose estimates would be considered high by an order of magnitude. However, in EPA's judgment, the values used to estimate source terms and doses are realistic based on the information available.

7.3 Control Technology

No comments.

7.4 Proposed Limits

Comment 7.4.1: The EPA should adopt the following recommendations to reduce radionuclide emissions from coal burning:

1. Change the NSPS for large industrial boilers to the NSPS for utility boilers;
2. Establish a NSPS limit of 0.1 lb/MMBtu or less for small industrial boilers;
3. Require existing large utility and industrial boilers to limit emissions to 0.1 lb/MMBtu; and

4. Require that replacement particulate controls be limited to 0.03 lb/MMBtu for large industrial and utility boilers, and 0.1 lb/MMBtu for units less than 250 MMBtu/HR. (G-21)

Response: These recommendations, with the exception of the second, require added control technology to reduce particulate emissions. The second recommendation refers to New Source Performance Standards (NSPS) for small industrial boilers for which a limit has not yet been set. EPA considered reducing radionuclide emissions by reducing particulate emissions, but concluded that the cost of additional control technology for new boilers and retrofitting existing boilers with best available control technology is not warranted by the small increase in health benefits estimated to accrue from the added control. (See response to Comments 7.1.1a through e.)

7.5 Implementation

No comments.

7.6 Costs

Comment 7.6.1: Attempts to further control particulate emissions will cause control costs to rise significantly with very little additional particulate reduction benefit. Radioactive elements cannot be further beneficially controlled with existing particulate control systems at about half the plants (i.e., those plants 10 or less years old). (G-15)

Response: EPA agrees.

Comment 7.6.2a: The absolute magnitude of costs imposed by a given level of control is relevant in judging how much control of emissions is warranted. The EPA has underestimated the capital, operating, and maintenance costs for further particulate control. The cost-per-life saved is such a high value that an extremely costly standard could create its own health risks due to associated activities or economic dislocation (i.e., higher fuel costs lowering household disposable income, construction-related accidents, or replacement energy production health impacts). (I-4b, I-48)

Comment 7.6.2b: Control costs presented are grossly exaggerated. No supporting cost data were presented in the BID. (P-17)

Response (Comments 7.6.2a and b): While one commenter asserts that EPA has underestimated costs of controls to reduce particulates, another states that control cost estimates are exaggerated. In EPA's opinion, the costs are not unrealistic. Information to support the cost data may be found in a report prepared by Radian Corporation for EPA (see Docket #A79-11, Document #II-E-6-7).

Comment 7.6.3: The EPA estimated the retrofit costs of the entire industry, not those facilities most in need of regulation. Yet the cost-benefit analysis did not include the benefit from the significant reduction of other pollutants as well. That is, the entire cost of controls was measured solely against the incremental reduction of radionuclide emissions. (P-3b)

Response: When estimating retrofit costs of the entire industry, EPA did take into consideration that some facilities had better emission controls than others.

EPA agrees that it would be best if a cost-benefit analysis considered all hazardous pollutants, not just radionuclides. However, this calculation cannot be done based on information that is available now. Furthermore it is not likely, should such a calculation be made and additional controls proposed as the result, that radionuclide emissions would play a significant part in the decision.

7.7 Other Comments

No comments.

8.0 PHOSPHATE INDUSTRY

8.1 Basis for the Standard

Comment 8.1.1a: Radon-222 emissions from phosphate mining and gypsum piles have been ignored by EPA. The EPA should propose standards for radionuclide emissions from phosphate mining and phosphoric acid plants because the phosphate industry mines more total uranium than the uranium industry, and counties with phosphate mining and processing facilities frequently also have significantly elevated rates of mortality from lung cancer. (P-2a, P-2b)

Comment 8.1.1b: The EPA's analysis of the phosphate industry is totally inadequate since it ignores emissions from mining and beneficiation. The EPA's 1979 analysis shows significant emissions from these activities. The current assessment also ignores radon from drying and grinding. (P-15a)

Comment 8.1.1c: The EPA has no basis for regulating radon emissions from phosphogypsum and clay wastes. The actual radon flux from clay wastes is almost non-existent because the material is <10 percent solids and radon is not very soluble. The radon flux from phosphogypsum approximates the level proposed by the EPA as the ("overly restrictive") standard for uranium mill tailings. (I-45)

Response (Comments 8.1.1a through c): EPA did not assess radon-222 emissions from phosphate mining and gypsum piles in determining the need for standards for the phosphate industry because the sources of these emissions are waste piles which the Agency believed, at the time of proposal of the standards, would better be considered under the Resource Conservation and Recovery Act (RCRA). In response to these comments, EPA is now carrying out an assessment of the radionuclide emissions to air from phosphate gypsum piles. No assessment is planned for evaluation of releases from mining activities since, based on available information of mining practices, it is not likely this constitutes a significant source of emissions.

EPA did not ignore the radon-222 emissions in its assessments of phosphate rock drying and grinding plants; rather it concluded, based on previous assessments, that these emissions were small and further consideration of the impact of the emissions was not necessary.

Comment 8.1.2a: EPA should use the same reasonably available control technology basis it applied to the source categories it proposed to regulate when considering whether to regulate the radionuclide emissions from the other phases of the phosphate industry. (G-21)

Comment 8.1.2b: We support the EPA's model facilities approach and agree with its conclusions that the risks are acceptable and no further regulations are required. (I-24, I-35)

Response (Comments 8.1.2a and b): EPA did use the same factors in determining the need for standards for the phosphate industry facilities as it used for source categories for which standards were proposed. These factors were described in the Federal Register Notice on the proposed standards (FR 48 15076).

8.2 Dose and Risk Calculations

Comment 8.2.1a: The EPA overestimated radionuclide emissions from the phosphate industry. EPA's analysis of the phosphate industry was overly conservative. In addition, the EPA's analysis did not take into account future reductions in emission levels that will occur as a result of emission regulations established under Sections 108, 111, 165, 172, and 173 of the Clean Air Act. Thus, the EPA has more than adequate justification for its determination that standards for radionuclide emissions in the phosphate industry are unnecessary. (I-45, I-46, I-53) (I-36b)

Comment 8.2.1b: The EPA assumed that all emissions from proces within the phosphate fertilizer industry have radionuclide concentratio equal to that of the product. In fact, much of the particulate emissions consist of clays, sand, or fluorosilicates. The percentage of P_2O_5 in the emissions should be used as a means of estimating the radionuclide concentrations. (I-45)

Comment 8.2.1c: The particulate emission factors used by EPA for rock dryers, granular triple superphosphate production, and diammonium phosphate production exceeded the highest average emission rates submitted during public hearings by factors of 4.2, 2.2, and 2.0, respectively. (I-45)

Comment 8.2.1d: The EPA should have used actual or average particulate emissions in their calculations rather than maximum allowable emission levels. Emissions have thus been overestimated by a factor of 2 to 4. (I-36b, I-45)

Comment 8.2.1e: The distances to the maximum individuals used by EPA were much less than the distances that actually occur in the industry. (I-36b, I-45)

Comment 8.2.1f: The EPA used a regional population of 1,400,000, which may be typical of central Florida, but does not represent Pocatello, Idaho, where the regional population is 138,000. (I-36b)

Response (Comments 8.2.1a through f): EPA estimated the radionuclide emissions from phosphate rock processing facilities based on information on the radionuclide concentration of phosphate rock and the amount of particulate matter which could be emitted under existing regulations for control of particulates. The specific activity of the particulate matter emitted was assumed to be equal to the specific activity of the phosphate rock. EPA agrees that this procedure is conservative when applied to the entire phosphate industry. The emission estimates used are most likely representative of upper limits representative of a few facilities with the highest emissions. The likelihood that the emission estimates are conservative or upper limit estimates only reenforces EPA's decision that standards are not needed for these types of facilities.

EPA believes that the locations used to estimate risk to the most exposed individuals are realistic locations, representative of places where people actually live. The use of a Central Florida site to estimate population risks from phosphate rock processing is appropriate because more than 75 percent of the phosphate rock processing takes place in Florida. Use of a different site to represent that segment of the industry located in less populated areas would not significantly change the population impact assessment.

Comment 8.2.2a: Many of the calculations and statements in a Florida Department of Environmental Regulation report relating to emissions from gypsum stacks are inaccurate and incorrect. (I-46)

Comment 8.2.2b: The EPA's Horton Report regarding radon exhalation from phosphate gypsum piles is inadequate. (P-2a, P-2b)

Response (Comments 8.2.2a and b): EPA did not assess radon-222 emissions from gypsum piles in determining the need for standards for the phosphate industry (see response to Comment 8.1.1). The usefulness of the information in the cited reports will be considered by EPA in its future assessments of gypsum piles.

Comment 8.2.3: The predicted doses from the phosphate industry in the BID are significantly lower than those given in the 1979 EPA document, "Radiological Impact Caused by Emissions of Radionucides into Air." (P-2a, P-2b)

Response: The assessments presented in the 1979 report "Radiological Impact Caused by Emissions of Radionuclides into Air" were preliminary assessments based on information (and assessment methodology) available at that time. The assessments presented in the Background Information Document supporting the proposed standards were based on the latest available information and assessment methodology.

Comment 8.2.4: The regional population figures based on the 1970 census are grossly inadequate for current risk projections in Florida. (P-2a, P-2b)

Response: The population of Florida as a whole increased by 43.4 percent between 1970 and 1980. Had the 1980 census data been available for our assessment, the estimated doses to the regional populations in our assessments of rock processing and wet process fertilizer plants would have been about 50 percent higher. The estimated exposures of the nearby individuals would not be affected. The greater impacts on the regional population would not change our overall assessment of the need for standards for these segments of the phosphate industry.

8.3 Control Technology

Comment 8.3.1: It is unlikely that the control systems on phosphate rock dryers work as they are proposed to work because the whole machinery has to be shut down for cleaning, and this is unlikely to happen. (P-2a, P-2b)

Response: The efficiency achieved by control systems does, in part, depend on proper cleaning and maintenance. However, the Agency does not agree that such maintenance is unlikely to occur, even in those systems where the machinery must be shut down for cleaning. Process equipment is not operated on a continuous duty cycle; thus, cleaning can be scheduled for down times. Further, the emission limits imposed by state implementation plans assure that controls will be maintained to achieve the requisite level of efficiency.

Comment 8.3.2: Even if polonium-210 is volatilized in the calciners, it will probably recondense on the particulates in the gas stream before it reaches the pollution control system and be removed along with the particulates. Tests of a pollution control system (with a replacement scrubber installed in 1975) on a calciner owned by the commenter indicated the control efficiency varied from 99.3 to 99.8 percent. (I-36b)

Response: EPA has conducted radionuclide emission testing of phosphate rock calciners at two wet process fertilizer plants. Data from one of these plants show only relatively small quantities of lead-210 and polonium-210 are released to air. However, data from the second plant show substantial quantities of these radionuclides are released. EPA has not yet completed its analysis of these data or assessed the risks resulting from these emissions.

8.4 Proposed Limits

Comment 8.4.1: The 10 mrem per year standard is unrealistically low. A person living in Colorado is exposed to 40 mrem per year more than someone living near the EPA reference phosphate fertilizer facility in central Florida. A dose no lower than 50-60 mrem per year should be considered. The EPA should also consider the maximum annual radiation dose of 500 mrem per year and 100 mrem per year established by the National Council on Radiation Protection and Measurements and the International Council on Radiation Protection and Measurements. (I-36b)

Response: EPA did not propose any radionuclide standards for phosphate fertilizer facilities. The 10 mem/yr standard referred to in the comment was the level of the standard proposed for NRC licensed facilities.

8.5 Implementation

No comments.

8.6 Costs

Comment 8.6.1: The EPA's estimates of the pollution control costs for new equipment or plant modifications are within 25 percent of industry estimates. Retrofit costs for DAD and GTSP plants are low by a factor of 2 to 2 1/2, based on recent industry experience. (I-45)

Response: EPA recognizes that some uncertainty exists in its cost estimates for pollution control equipment for phosphate rock processsing facilities and that greater uncertainty exists in retrofit costs compared to new plants. The cost estimates presented in the final BID are presented only as approximate costs.

8.7 Other Comments

No comments.

9.0 OTHER EXTRACTION INDUSTRIES

9.1 Basis for the Standard

Comment 9.1.1a: The EPA has supplied no basis for treating annual emissions from mineral extraction activities as an extreme hazard for regulation under Section 112 of the CAA. (I-47)

Comment 9.1.1b: Emissions and exposures are so insignificant as to preclude regulation under any program under the CAA. (I-3b, I-12, I-47)

Comment 9.1.1c: Small emissions from the mineral extraction industries must be considered de minimis and do not present a significant risk to public health. (I-3b, I-12, I-47)

Comment 9.1.1d: Exposures attributable to radon and its decay products are acceptable as defined by 40 CFR 190 even with background included. (I-47)

Comment 9.1.1e: When compared to natural sources and other risks, potential health effects from the minerals' extraction industries are insignificant. (I-3b, I-47) The risk due to the mineral extraction industries conservatively computes to 1 to 6 x 10^8, which is extremely small compared to risks involved in daily life. (I-47)

Response (Comments 9.1.1a through e): EPA did not propose air emissions standards for mineral extraction industries facilities. The available data at time of proposal showed that the radiation doses to individuals and populations from radionuclide emissions from these types of facilities were relatively small and could not be reduced at reasonable cost. EPA has continued to analyze information from its studies of radionuclide emissions from the mineral extraction industries. These further evaluations confirmed our previous conclusion about the need for standards.

When EPA promulgated the 40 CFR 190 standards, it excluded radon-222 and its daughter products from the standards. This exclusion did not mean that the exposures from radon-222 were acceptable but rather that the Agency believed that additional time was required to develop an appropriate standard for radon-222 and its daughter products.

Comment 9.1.2: The minerals' extraction industries are already subject to controls under Sections 108 and 111 of the Clean Air Act that would reduce particulate emissions. (I-3b)

Response: The effect of current standards under the CAA or other applicable legislative authority was taken into consideration by EPA in determining the need for a radionuclide emission standard under Section 112 (see FR 48 15076).

Comment 9.1.3: The EPA incorrectly listed radon or other radionuclides from mineral extraction activities for purposes of Section 122. The major radioactive releases are ubiquitous in the natural environment. The mineral extraction industries contribute 0.4 percent of natural background emissions, well within the range of naturally occurring variations. (I-47)

Response: Section 122 of the Act required the Administrator to determine whether emissions of radioactive pollutants cause or contribute to air pollution that may reasonably be anticipated to endanger public health. Section 122 did not exclude naturally occurring radionuclides.

Comment 9.1.4: It is unfortunate that the EPA does not propose to use the same reasonably available control technology basis it applied to the source categories it proposes to regulate to the radionuclide emissions from metal mining and milling facilities. (G-21)

Response: EPA did use the same basis in determining the need for standards for the mineral extraction industry as it used for source categories for which standards were proposed. These factors were described in the Federal Register notice on the proposed standards (48 FR 15076).

9.2 Dose and Risk Calculation

Comment 9.2.1: The EPA's estimates of emissions and doses are not best estimates. The EPA has significantly overestimated the risk of mining-related categories to both regional populations and maximally-exposed individuals. The magnitude of the estimated maximum individual risks and population doses would be reduced if more reasonable assumptions and parameters were considered. (I-3b)

Response: The Agency disagrees that radiation risks to both nearby individuals and populations were significantly overestimated for the extraction industries. These risks are reduced in the final BID by a factor of 2.5 as discussed in Chapter 8, Vol. 1, since almost all risk was from high-LET radiation.

The radiation risks presented in the draft BID were from preliminary assessments of the extraction industries. A more detailed analysis of the measurements made at extraction industry facilities has been completed and the results presented in the final BID. These results are both higher and lower than those presented in the draft BID. The Agency believes the risk values listed in the final BID are reasonable estimates based on measured emissions and on widely accepted models for pathways and receptor risk as discussed in Volume 1, Chapters 7, 8, and 9 of the final BID.

Comment 9.2.2: The risk associated with radon is slight because it is dispersible and has no daughter products. Radon concentrations are principally affected by local geography and micrometeorology. (I-47)

Response: These factors are taken into consideration in estimating risk from radon. Dispersion of radon in air as it travels is included in the calculation of radon concentration at various distances from the source. Growth of radon daughters during travel is also calculated. So the radon-radon daughter concentration at any point as calculated includes dispersion and in-growth of daughters. As shown in response to Comment 5.2.1e, growth of daughters for radon entering a structure was also calculated.

Any data on local geography or micrometeorology could also be considered and perhaps incorporated into the calculations. However, the calculations in the Background Information Document were of a generic nature, not site specific.

9.3 Control Technology

No comments.

9.4 Proposed Limits

No comments.

9.5 Implementation

No comments.

9.6 Costs

Comment 9.6.1a: The application of additional control technology to reduce small risks due to radon would be neither reasonable nor practicable. (I-3b, I-47)

Comment 9.6.1b: There are no technological means available at reasonable cost to further reduce fugitive and controlled emissions of particulate matter from extractive and processing operations. (I-12)

Comment 9.6.1c: Stringent controls on the extractive mineral industries for radon would impose an economic penalty that would insure reliance on undependable foreign sources and, through conservation measures, expose the public to higher risks. (I-47)

Response (Comments 9.6.1a through c): See response to Comments 9.1.1.a through 9.1.1.e.

9.7 Other Comments

No comments.

10.0 URANIUM FUEL CYCLE FACILITIES, URANIUM MILL TAILINGS, AND MANAGEMENT OF HIGH-LEVEL WASTE

10.1 Basis for the Standard

Comment 10.1.1a: The EPA's proposed decision not to issue radionuclide standards for uranium fuel cycle facilities covered under 40 CFR 190 is appropriate. The 40 CFR 190 standards, in conjunction with the NRC's regulation of these facilities, protect public health with an ample margin of safety. Additional regulation is not needed, and the decision not to propose standards for uranium fuel cycle facilities is in keeping with the Congressional mandate to avoid duplicative regulation. (G-2a, G-2b, I-1b, I-3b, I-4a, I-4b, I-44, I-48, I-51)

Comment 10.1.1b: We concur with the EPA's decision not to issue new radionuclide emission standards for uranium-fueled light-water reactors. Current standards are adequate to protect the public health with an ample margin of safety. (I-5, I-48, I-50)

Comment 10.1.1c: The Act requires the EPA to set emission standards for the uranium fuel cycle, even though standards already exist under other authorities. The legislative history of Section 112 of the 1977 amendments makes it clear that this was Congress's intent. (P-15a, P-15b)

Response (Comments 10.1.1a through c): EPA carefully considered its decision not to propose radionuclide emission standards under the Clean Air Act for uranium fuel cycle facilities. EPA fully considered the position that there is no discretionary choice and that the Act requires such a standard. EPA does not believe it was the intent of Congress that duplicative standards be issued if standards under other authorities exist.

For uranium fuel cycle facilities, EPA concludes that Clean Air Act standards are not justified or needed at this time for the following reasons:

a. EPA has recently promulgated emission standards for the Uranium Fuel Cycle (40 CFR 190) under the authority of the Clean Air Act.

b. These standards limit emissions to low levels, thus limiting risks to low levels also.

c. 40 CFR 190 is protective of public health with ample margins of safety.

d. Part 190 standards apply to all pathways, including direct radiation, and for all sources that affect a single individual. For this reason, direct comparison with a Clean Air Act standard is not possible; but for a given limit the Part 190 standard is more conservative because it limits emissions from all pathways, not just emission to air.

Therefore, EPA believes a Clean Air Act standard for uranium fuel cycle facilities would represent an unreasonably large expenditure of effort to achieve a result that would not be significantly different from the regulations now enforced by EPA under the Atomic Energy Act. This would be unreasonable.

Comment 10.1.2: The EPA's proposed decision not to issue radionuclide standards for uranium milling activities under Section 112 is appropriate. The current standards are more restrictive than required under either the Atomic Energy Act, as amended, or the Clean Air Act. Radon from uranium mill tailings does not pose a significant threat to public health within the meaning of either the Clean Air Act or the Uranium Mill Tailings Radiation Control Act. (I-3b, I-50)

Response: The arguments for not regulating uranium milling activities under the Clean Air Act are much the same as for uranium fuel cycle facilities (see response to Comment 10.1). EPA has promulgated standards for inactive tailings piles for both active and inactive uranium mills under the Uranium Mill Tailings Radiation Control Act of 1978. This was a major long-term effort that limits the risks from tailings piles to low levels and thus protects the public with an ample margin of safety.

The tailings piles are the source of radon-222 emissions which is the most serious source of risk due to air emissions from milling. Other kinds of particulate emissions to air from mills are limited by the Part 190 standard.

Comment 10.1.3a: The EPA should set radionuclide standards for operating uranium mill sites. The language of the UMTRCA, Section 2022(e), clearly preserves the Agency's duty to regulate radioactive pollutants at uranium mill sites under the Clean Air Act. (G-20, P-3b, P-15b)

Comment 10.1.3b: At present, there are no radiological performance standards for uranium mills and associated tailings piles under the UMTRCA. Thus, the EPA should amend its proposed Clean Air Act standards to cover active uranium mills or set a new NESHAP standard. (G-5, G-20, P-15a)

Response (Comments 10.1.3a and b): Air particulate emissions from licensed mills are limited by the Part 190 standard for the uranium fuel cycle as noted above. What is not covered by that standard or by EPA's standards under the Uranium Mill Tailings Radiation Control Act are radon-222 emissions from licensed uranium mill tailings piles.

EPA agrees that radon emissions from active piles are not limited by EPA standards, but only by NRC regulations to that amount causing a concentration of 4 pCi/l in unrestricted areas. This is considerably higher than EPA's final rule for uranium mines. EPA agrees this inconsistency should be investigated and is publishing an Advance Notice of Proposed Rulemaking to this effect.

Comment 10.1.4a: The EPA's decision not to regulate waste disposal sites is illegal and must be reversed. (P-15b)

Comment 10.1.4b: The decision not to issue standards for several source categories, particularly nuclear power plants, is a serious oversight. (P-13b)

Response (Comments 10.1.4a and b): The arguments for not regulating the management of high level radioactive waste under the Clean Air Act are much the same as for uranium fuel cycle facilities (see response to Comment 10.1). EPA has proposed and intends to promulgate emission standards for this source. The proposed standard is identical to the standard for the uranium fuel cycle and is issued under the same authority, the Atomic Energy Act. It limits emissions to low levels, thus also limiting risks and protecting the public health with an ample margin of safety.

A second standard issued under the Clean Air Act would not serve a useful purpose and would be unreasonable. EPA has chosen not to propose such a standard.

Comment 10.1.5: The proposed 10 mrem/yr limit could impact the required review of 10 CFR 190 limits. Since the limits of 10 CFR 190 are already restrictive enough, we suggest the EPA reexamine the 10 mrem/yr proposed standard from a cost/benefit viewpoint to assure an adequate regulatory basis for its decision. (I-50)

Response: The proposed 10 mrem/y limit has been withdrawn. The cost-benefit viewpoint has been previously discussed. (See response to Comment 2.1.7.) Also, the reasons for not proposing Clean Air Act standards for uranium fuel cycle standards have been previously discussed (See response to Comment 10.1.1).

10.2 Dose and Risk Calculations

No comments.

10.3 Control Technology

No comments.

10.4 Proposed Limits

Comment 10.4.1: The existing 10 CFR 190 limits cannot be said to provide an "ample margin of safety" when 10 mrem/yr is required to provide an ample margin of safety from DOE and other NRC-licensed activities. (P-15a)

Response: "An ample margin of safety" is not a single value but may vary within limits for different sources. In this particular case, the 10 CFR 190 limits are not greatly different from the Clean Air Act proposed standard for DOE facilities but they cannot be directly compared because of differences (see response to Comment 10.1.1). This argument cannot be reasonably used to show that 10 CFR part 190 does not provide an ample margin of safety.

10.5 Implementation

No comments.

10.6 Costs

No comments.

10.7 Other Comments

No comments.

11.0 LOW-ENERGY ACCELERATORS

11.1 Basis for the Standard

Comment 11.1.1: We agree with the EPA's decision not to propose standards for low-energy accelerators. (I-19)

Response: Our analysis of low-energy accelerators found the risks from such facilities to be negligible.

11.2 Dose and Risk Calculations

No comments.

11.3 Control Technology

No comments.

11.4 Proposed Limits

No comments.

11.5 Implementation

No comments.

11.6 Cost

No comments.

11.7 Other Comments

No comments.

APPENDIX A.

Appendix A Government Commenters

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
G-1	III-53	Alvin W. Trivelpiece Director of Energy Research Department of Energy Washington, D.C. 20585	07-14-83	07-14-83
G-1	III-J-01	Dr. Alvin Trivelpiece Department of Energy EP-321 Washington, D.C. 20545	04-28-83	05-03-83
G-2	III-B-07	William J. Dircks Executive Director for Operations U.S. Nuclear Regulatory Commission Washington, D.C. 20555	06-21-83	06-24-83
G-2	III-J01	Dr. William Mills U.S. Nuclear Regulatory Commission Office of Regulatory Research Washington, D.C. 20555	04-28-83	05-03-83
G-3	III-B-06	William H. Spell State of Louisiana Department of Natural Resources Nuclear Energy Division P.O. Box 14690 Baton Rouge, Louisiana 70898	06-06-83	06-10-83
G-4	III-E-06	John F. Kowalczyk, Supervisor State of Oregon Department of Environmental Quality Air Quality Division 522 S.W. Fifth Avenue Box 1760 Portland, Ogegon 97207	05-24-83	06-10-83
G-5	III-E-07	Robert R. Mooney, Supervisor State of Washington Department of Social Health Services Environmental Radiation and Emergency Response Unit 1409 Smith Tower B17-9 Seattle, Washington 98104	06-14-83	06-20-83
G-6	III-C-01	Randy Brich Office of Air Quality and Solid Wste Dakota Department of Water and and Natural Resources Joe Foss Building 523 East Capitol Pierre, South Dakota 57501	05-10-83	05-17-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
G-7	III-58	James E. Watson, Jr. (Chairman) The Northe Carolina Radiation Protection Commission Department of Natural Resources P.O. Box 12200 Raleigh, North Carolina 27605-220	07-12-83	07-15-83
G-8	III-19	Seymour Abrahamson (Chairman) Wisconsin Radiation Protection Council Zoology Research Building 1117 West Johnson Street Madison, Wisconsin 53706	05-20-83	05-25-83
G-9	III-26	L. D. Lukin, P.E. Director, Division of Environmental Programs Florida Department of Environmental Regulation Twin Towers Office Building 2600 Blair Stone Road Tallahassee, Florida 32301-8241	05-26-83	06-02-83
G-10	III-29	Lillian Roberts Commissioner of Labor New York Department of Labor Two World Trade Center New York, New York 10047	05-26-83	06-20-83
G-11	III-30	James C. Hardeman, Manager Environmental Radiation Program Georgia Department of Natural Resources 290 Washington Street, S.W. Atlanta, Georgia 30334	06-01-83	06-21-83
G-12	III-31	Audrey V. Goodwin, Director Bureau of Radiological Health State Office Building Montgomery, Alabama 36130	06-21-83	06-24-83
G-13	III-32	Mohamed T. El-Ashry, Ph. D. Director of Environmental Quality Tennessee Valley Authority Knoxville, Tennessee 37902	06-21-83	06-23-83
G-14	III-37	Lee W. Stokes, Ph.D. (Administrator) Division of Environment Idaho Dept. of Health and Welfare Statehouse Boise, Iowa 83720	07-5-83	07-12-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
G-15	III-41	Prem S. Bhardwaja Environmental Services Salt River Project Box 1980 Phoenix, Arizona 85001	07-11-83	07-14-83
G-16	III-50	Jerry L. Calhoun Acting Principal Deputy Assistant Secretary of Defense, Department of Defense Washington, D.C 20301	07-14-83	07-14-83
G-17	III-64	Henry G. Williams State of New York Department of Environmental Conservation Albany, New York 12233-0001	07-13-83	07-18-83
G-18	III-69	Lawerence R. Jacobi, P.E. General Manager Texas Low-Level Radioactive Waste Disposal Authority 1300-C East Anderson Lane, Suite 175 Austin, Texas 78752	07-13-83	07-20-83
G-19	III-74	Bruce Blanchard, Director Environmental Project Review Department of the Interior Office of the Secretary Washington, D.C. 20240	07-15-83	07-20-83
G-20	III-C-05	Toney Anaya, Governor State of New Mexico Santa Fe, New Mexico 87503	07-18-83	08-12-83
G-21	III-E-10	Steven G. Kuhrtz, Director State of New Jersey Department of Environmental Protection Division of Environmental Quality John Fitch Plaza, CN027 Trenton, New Jersey 08625	07-21-83	08-01-83
G-22	III-J-09	The Honorable Gary Hart U.S. Senator State of Colorado 221 Russell Senate Office Building Washington, D.C. 20510	06-14-83	07-01-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
G-23	III-79	David Axelrod, M.D. State of New York Department of Health Albany, New York (forwarded by Paul Giardina, Reg. II)	06-29-83	08-02-83
G-24	III-J-09	James Greir James Lents Colorado Department of Health 4210 East 11th Avenue Denver, Colorado	06-14-83	07-01-83
G-25	III-J-09	Gerald Stewart State of New Mexico Uranium Licensing Section Albuquerque, New Mexico	06-14-83	07-01-83
G-26	III-J-09	Ronald L. Ostop Superintendent of Environmental Affairs Colorado Springs Department of Utilities Colorado Springs, Colorado	06-14-83	07-01-83

APPENDIX B.

Appendix B Industry Commenters

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
I-1	III-J-09	Dr. Calvin Brantley Atomic Industrial Forum 549 Albany Street Boston, MA 02118	06-14-83	07-01-83
I-1a	III-J-01	Dr. Shepard Bartnoff Atomic Industrial Forum, Inc. 7101 Wisconsin Avenue Bethesda, Maryland 20814	04-29-83	05-03-83
I-1b	III-52	Carl Walske (President) Atomic Industrial Forum, Inc. 7101 Wisconsin Avenue Bethesda, Maryland 20814	07-14-83	07-14-83
I-2	III-67	Jack G. Peterson Executive Director and Chief Economist Idaho Mining Association Post Office box 1660 Boise, Idaho 83701	07-11-83	07-19-83
I-2	III-J-01	Jack G. Peterson Executive Director and Chief Economist Idaho Mining Association Post Office box 1660 Boise, Idaho 83701	04-29-83	05-03-83
I-2	III-J-09	Jerry Reeve Greater Pocatello, Idaho Chamber of Commerce Pocatello, Idaho (With Idaho Mining Association)	06-14-83	07-01-83
I-2	J-09	Dr. Lynn Anderson 1448 East Center Pocatello, Idaho 83201 (With Idaho Mining Association)	06-14-83	07-01-83
I-3	III-56	J. Allen Overton, Jr. (President) American Mining Congress 1920 N Street, N.W. Suite 300 Washington, D.C. 20036	07-14-83	07-14-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
I-3	III-J-01	John Zimmerman American Mining Congress 1920 North Street, N.W. Suite 300 Washington, D.C. 20036	04-28-83	05-03-83
I-3	III-J-09	Dr. Marvin Goldman American Mining Congress 1920 North Street, N.W. Suite 300 Washington, D.C. 20036	04-28-83	07-01-83
I-4	III-55	Henry V. Nickel, et. al Hunton and Williams 1919 Pennsylvania Avenue, N.W. P.O. Box 19230 Washington, D.C. 20036 (On behalf of the Utility Air Regulatory Group)	07-14-83	07-14-83
I-4	III-80	F. William Brownell Hunton and Williams 1919 Pennsylvania Avenue, N.W. P.O. Box 19230 Washington, D.C. 20036 (On behalf of the Utility Air Regulatory Group)	08-11-83	08-12-83
I-4	III-J-01	F. William Brownell Hunton and Williams 1919 Pennsylvania Avenue, N.W. P.O. Box 19230 Washington, D.C. 20036 (On behalf of the Utility Air Regulatory Group)	04-28-83	05-03-83
I-5	III-H-01	Yankee Atomic Electric Company 1671 Worchester Road Framingham, MA 01701	07-14-83	07-18-83
I-6	III-B-03	Henry C. Briggs (Radiation Safety Officer) Indiana University Department of Environmental Health and Safety 625 North Jordan Avenue Bloomington, Indiana 47405	05-06-83	05-12-83
I-7	III-B-04	Nathan J. Treinish (Attorney) Abbott Laboratories Abbott Park North Chicago, Illinois 60064	05-27-83	05-31-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
I-8	III-A-02	Lincoln Clark, Jr. (Chairman) National Organization of Test Research and Training Reactors (TRTR) c/o Nuclear Reactor Laboratory, MIT 138 Albany Street Cambridge, Massachusetts 02139	05-26-83	06-02-83
I-8	III-B-11	Lincoln Clark, Jr. (Chairman) National Organization of Test Research and Training Reactors (TRTR) c/o Nuclear Reactor Laboratory, MIT 138 Albany Street Cambridge, Massachusetts 02139	07-12-83	07-20-83
I-9	III-E-08	John R. McNamara, Chairman West Associates Management Committee P.O. Box 1980 Phoenix, Arizona 85001	07-07-83	07-22-83
I-10	III-F-01	Frank B. Silvestro, Vice President Ecology and Environment, Inc. 195 Segg Road P.O. Box D Buffalo, New York 14225	05-04-83	05-06-83
I-11	III-F-02	Thomas J. Sayers, (Administrator) Environmental Control Stauffer Chemical Company Westport, Connecticut 06881	05-12-83	05-17-83
I-12	III-G-01	D.S. Cahn, (Vice President) Regulatory Matters California Portland Cement Company P.O. Box 17964 Los Angeles, California 90017-0964	05-27-83	06-10-83
I-13	III-H-04	Timothy R. Gablehouse Manager Regulatory Affairs Adolf Coors Company Golden, Colorado 80401	05-24-83	05-27-83
I-14	III-H-05	David T. Modi E.I. duPont de Nemours & Co. Legal Department Wilmington, Deleware 19898	05-25-83	06-02-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
I-15	III-C-02	Lyda W. Hersloff, Ph.D. Rocky Mountain Energy 10 Longs Peak Drive Box 2000 Broomfield, Colorado 80020	05-18-83	06-01-83
I-16	III-C-03	C.E. Wolff, Resident Manager Mortin Ranch Project Silver King Mines, Inc. P.O. Box 560 Casper, Wyoming 82602-0560	06-29-83	07-05-83
I-17	III-C-04	J.P. McCluskey Executive Vice President Cotter Corporation Suite 201 9305 West Alameda Parkway Lakewood, Colorado 80226	07-14-83	08-01-83
I-18	III-02	Janet Trunzo (Radiation Safety Officer) Scripps Clinic and Research Foundation 10666 North Torrey Pines Road La Jolla, California 92037	04-27-83	05-02-83
I-19	III-B-12	John Jennings Pharmaceutical Manufacturers Assoc. 1100 Fifteenth St., N.W. Washington, D.C. 20005	07-14-83	07-22-83
I-20	III-66	Gary H. Baise Beveridge and Diamond, P.C. 1333 New Hampshire Avenue, N.W. Washington, D.C. 20036 (On behalf of FMC Industrial Chemical Group, Philadelphia)	07-14-83	07-19-83
I-20	III-J-09	Gary H. Baise, Dan Scroggins Beveridge and Diamond, P.C. 1333 New Hampshire Avenue, N.W. Washington, D.C. 20036 (On behalf of FMC Industrial Chemical Group, Philadelphia)	06-14-83	07-01-83
I-21	III-77	A.E. Scherer, Director Nuclear Licensing C-E Poser Systems Combustion Engineering, Inc. 1000 Prospect Hill Road Windsor, Connecticut	07-19-83	07-26-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
I-22	III-38	Grey Bogden (Director) Environmental & Industrial Safety Western Nuclear, Inc. Executive Office 134 Union Boulevard Lakewood, Colorado 80228	07-12-83	07-13-83
I-23	III-76	Pathfinder Mines Corporation 550 California Street San Francisco, California 94104	07-11-83	07-20-83
I-24	III-75	J Jeffrey Zimmerman Occidental Petroleum Corporation 10889 Wilshire boulevard Suite 1500 Los Angeles, California 90024	07-13-83	07-20-83
I-25	III-21	Jacob C. Stucki The UpJohn Company Kalamazoo, Michigan 49001	05-26-83	05-31-83
I-26	III-73	E.W. Shortridge, Chairman Uranium Committee The Colorado Mining Association 410 Denver Hilton Office Building 1515 Cleveland Place Denver, Colorado 80202-5192	07-14-83	07-20-83
I-27	III-27	W. G. Council (Sr. Vice President) Northeast Utilities Service P.O. Box 270 Hartford, Connecticut 06141-0270	05-26-83	06-07-83
I-28	III-28	Adrienne E. Shirk (Attorney) Medi-Physics, Inc. 340 Kingsland Street Nutley, New Jersey 07110	06-01-83	06-09-83
I-29	III-33	Marvin W. Marsh, Vice President Mallinckrodt, Inc. 675 Brown Road St. Louis, Missouri 63134	07-01-83	07-01-83
I-30	III-72	H.N Wellhouser, Manager Compliance Administration GA Technologies, Inc. P.O. Box 81608	07-14-83	07-20-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
I-31	III-J-09	Geroge Rice, Charles H. Montange Kerr McGee P.O. Box 25861 Oklahoma City, Oklahoma 73125	06-14-83	07-01-83
I-32	III-43	Jerome M. Smith Vice President and Director, Medical Products New England Nuclear 549 Albany Street Boston massachusetts 02118	07-13-83	07-14-83
I-33	III-36	Otha W. Linton Director of Governmental Relations American College or Radiology 6900 Wisconsin Avenue Chevy Chase, Maryland 20815	07-8-83	07-12-83
I-33	III-J-09	Russell Ritenour American College of Radiology Health Science Center C-278 4200 East 9th Avenue Denver, Colorado 80262	06-14-83	07-01-83
I-33	III-J-01	Thomas Bruderle American College of Radiology Health Science Center C-278 4200 East 9th Avenue Denver, Colorado 80262	04-28-83	05-03-83
I-34	III-J-09	Al Hazle Conference of Radiatin Control Program Directors, Inc. 4210 Eash 11th Avenue Denver, Colorado	06-14-83	07-01-83
I-35	III-68	Joseph M. Baretincic, Manager Environmental Services & Quality Control International Minerals & Chemicals Corporation New Wales Operations P.O. Box 1035 Mulberry, Florida 33860	07-14-83	07-19-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
I-36	III-59	J.F. Cochrane (Director) Environmental Affairs Department J.R. Simplot Company P.O. Box 912 Pocatello, Idaho 83201	07-12-83	07-15-83
I-36	III-J-09	J. R. Cochrane (Director) Environmental Affairs Department J.R. Simplot Company P.O. Box 912 Pocatello, Idaho 83201	06-14-83	07-07-83
I-37	III-J-71	C.J. Konnerth, Manager Health, Safety & Environmental Affairs Union Carbide Corporation Medical Products Division P.O. Box 324 Tuxedo, New York 10987	07-11-83	07-20-83
I-37	III-J-09	Dr. Richard Beverly Director of Environmental Affairs Metal Division Union Carbide Corporation Medical Products Division Grand Junction, Colorado	06-14-83	07-01-83
I-38	III-63	Joyce P. Davis Chief Licensing Engineer General Physics Corporation 10650 Hielcory Ridge Road Columbia, Maryland 21044	07-12-83	07-18-83
I-39	III-D-01	J. H. Waldebeser (Manager) Environmental Operations Monsanto Industrial Chemicals Co. 800 N. Lindbergh Boulevard St. Louis, Missouri 63167	07-07-83	07-13-83
I-40	III-B-08	Linda A. Bagby (Manager) Environmental and Safety Regulatory Affairs Amersham Corporation 2636 South Clearbrook Drive Arlington Heights, Illinois 60005	07-06-83	07-13-83
I-41	III-35	Edmond E. Griffin, Ph.D. Medical Program Science Administrator American Heart Association National Center 7320 Greenville Avenue Dallas, Texas 75231	06-29-83	07-05-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
I-42	III-40	David F. Zoll Vice President, General Counsel Chemical Manufacturers Association 2501 M Street, N.W. Washington, D.C. 20037	07-12-83	07-13-83
I-43	III-44	G. Stanley Crout (Attorneys) Stephenson, Carpenter, Crout, and Olmstead Bokum Building 142 W. Palace Avenue P.O. Box 669 Santa Fe, New Mexico 87504-0669 (on behalf of Homestake Mining Corp. and United Nuclear Corporation)	07-13-83	07-14-83
I-44	III-46	George P. Green (Manager) Governmental Licensing & Planning Public Service Company of Colorado P.O. Box 840 Denver, Colorado 80201	07-08-83	07-14-83
I-45	III-48	Gary D. Meyers (President) The Fertilizer Institute 1015 18th Street, N.W. Washington, D.C. 20036	07-14-83	07-14-83
I-46	III-57	G.E. Wilkinson Gardiner Inc. P.O. Box 3269 Tampa, Florida 33601	07-11-83	07-15-83
I-47	III-49	Peter J. Nickles, Charles H. Montagne Covington and Burling 1201 Pennsylvania Avenue, N.W. Washington, D.C. (on behalf of Kerr-McGee Corp. Homestake Mining Co. & United Nuclear Corp.)	07-14-83	07-14-83
I-48	III-62	Joel D. Patterson Middle South Services Box 6100 New Orleans, Louisianna 70161	08-14-83	07-14-83
I-49	III-51	David W. Delcour (Vice President) External Affairs Climax Molybdenum Company Amax Inc. 1707 Cole Boulevard Golden, Colorado 80401	07-12-83	07-14-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
I-50	III-60	W.J. Hurford Carolina Power & Light Company P.O. Box 1551 411 Fayetteville Street Raleigh, North Carolina 27602	07-13-83	07-18-83
I-51	III-61	Ronald V. Shearin Duke Power Company Legal Department P.O. Box 33189 Charlotte, North Carolina 28242	07-14-83	07-18-83
I-52	III-J-09	Chris Shuey Southwest Research & Infor Center P.O. Box 4524 Albuquerque, New Mexico	06-14-83	07-01-83
I-53	III-90	American Petroleum Institute 2101 L. Street, Northwest Washington, D.C. 20037	07-14-83	No date

APPENDIX C.

Appendix C Public Commenters

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
P-1	III-J-01	Dr. Warren Sinclair National Council on Radiation Protection & Measurements 7910 Woodmont Ave. Suite 1016 Bethesda, Md. 20814	04-28-83	05-03-83
P-1b	III-45	Warren W. Sinclair (President) National Coucil on Radiation Protection & Measurements 7910 Woodmont Ave. Suite 1016 Bethesda, Md. 20814	07-14-83	07-14-83
P-2	III-F-03	Thomas W. Reese, Attorney at Law 123 Eighth Street North St. Petersburg, Florida 33701 (on behalf of Manasota-88, Inc., Booker Creek Preservation, Inc., and Manatee County Save our Bays Assoication, Inc.)	05-27-83	06-21-83
P-2	III-J-01	Gloria C. Rains Manasota-88 5314 Bay State Road Palmetto, Florida 33701	04-28-83	05-03-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
P-3	III-22	Walter G. Wells Conservation Chairman Potomac Chapter Sierra Club 3606 Veazey Street, N.W. Washington, D.C. 20008	05-23-83	06-01-83
P-3	III-42	Beers and Dickson 380 Hays Street, Suite One San Francisco, California 94102 (on behalf of the Sierra Club)	07-13-83	07-14-83
P-3	III-J-01	Kathryn Burkett Dickson Beers and Dickson 380 Hays Street, Suite One Civic Center San Francisco, California 94102 (on behalf of the Sierra Club)	04-28-83	05-03-83
P-4	III-E-01	Comment from "a curious citizen" no return address	04-14-83	04-26-83
P-5	III-E-o2	Peter B. Bossman, P.E. 14817 S.E. Raintree Court Milwaukie, Oregon 97222	04-29-83	05-03-83
P-6	III-E-03	N. Roy Greiner 9 Loma Vista Los Alamos, New Mexico 87544	05-18-83	05-24-83
P-7	III-03	C.G. Bacon 2960 Hannah Avenue Norristown, Pennsylvania 19401	No Date	05-02-83
P-8	III-B-02	W. J. Richards (Chairman) ANS-15 Research Reactor Standards Committee American Nuclear Society C/o Argonne National Laboratory P.O. Box 2528 Idaho Falls, Idaho 83401	05-04-83	05-11-83
P-9	III-B-09	Ralph G. Robinson, M.D. (President, American College of Nuclear Physicians), and Merle K. Loken, M.D., (President, Society of Nuclear Medicine) 1101 Connecticut Avenue, N.W. Suite 700 Washington, D.C. 20036	07-12-83	07-14-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
P-10	III-20	Mark P. Oncavage (President) Floridans United for Safe Energy, Inc. 87 Merrick Way Coral Gables, Florida 33134	05-28-83	05-31-83
P-11	III-23	William Boek, Ph.D. C/o Department of Physics Niagara University Niagara, New York 14109	05-25-83	06-02-83
P-12	III-24	Tim Johnson No address given	05-25-83	06-02-83
P-13a	III-34	Carl J. Johnson, M.D. 42 Hillside Drive Denver, Colorado 80215	06-14-83	07-01-83
P-13b	III-J-09	Carl J. Johnson, M.D. Medical Care and Research Center 42 Hillside Drive Denver, Colorado 80215	06-14-83	07-01-83
P-14	III-18	Gene J. Triano, M.D. (President) Pennsylvania Radiological Society	05-20-83	05-24-83
P-15	III-65	Robert E. Yuhnke Regional Counsel Environmental Defense Fund 1405 Arapahoe Avenue Boulder, Colorado 80302	07-14-83	07-18-83
P-15	III-J-09	Robert E. Yuhnke Regional Counsel Environmental Defense Fund 1405 Arapahoe Avenue Boulder, Colorado 80302	06-14-83	07-01-83
P-16	III-25	Roger J. Cloutier (President) Health Physics Society C/o Oak Ridge Associated University P.O. Box 117 Oak Ridge, Tennessee 37830	05-27-83	06-02-83
P-17	III-54	David D. Doniger, et. al. Natural Resources Defense Council, Inc. 1725 I Street, N.W. Suite 600 Washington, D.C. 20006	07-14-83	07-14-83

I.D. CODE	DOCKET NUMBER	COMMENTER	DATE OF SUBMISSION	DATE DOCKETED
P-18	III-39	Eric J. Boeldt 210 Ohio Avenue Madison, Wisconsin 53704	07-12-83	07-13-83
P-18	III-B-10	Eric J. Boeldt 210 Ohio Avenue Madison, Wisconsin 53704	07-12-83	07-15-83
P-19	III-47	Carl G. Benson Solado, Texas 76571	07-08-83	07-14-83
P-20	III-I-01	J. Clark Pontius 324 W. Chestnut Street Oxford, Ohio 45056	07-14-83	08-12-83